THE

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ELECTRICAL REVIEW.

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MUNICIPAL ELECTRICAL MATTERS.

MR. S. E. FEDDEN'S Presidential Address to the Municipal Electrical Association at Sheffield, this year, touches on several interesting and controversial points, affecting the welfare of the municipal electrical engineer and the undertakings which he controls, and is, in fact, quite a satisfactory outcome of the position of difficulty and discouragement which the President says, in his opening paragraphs, he faced in preparing his address.

We can heartily concur with him as to the utility of the Association in furthering the general interests of the municipal electrical undertaker, hedged in as the latter is by special, and only too frequently unnecessary, legislation. The united voice of such a body is an absolute necessity when dealing with legislative matters.

As regards the status of the electrical engineer, Mr Fedden touches briefly on the question of salaries and the frequent outcry against their increase; he suggests that the engineer must be resigned to these occasional outbursts, and endeavour to rob them of their point by the increasing extent and success of his department. In other words, the engineer in this, as in other walks of life, must justify his existence, a task more or less arduous according to his influence with his committee. The municipal councillor is almost of necessity a self-assertive being, more especially in those quarters where a little knowledge and a loud voice have stood him in good stead with his electors, and the instances of unnecessary interference with the engineer, which Mr. Fedden rightly deplores, as also numerous other adverse features of municipal work, are the natural and unavoidable accompaniments of such popular control.

In this connection Mr. Fedden's plea for the continuity of chairmen and engineers is important; the two men who have presumably guided the destinies of the undertaking ought not to be dispensed with too readily or frequently, particularly in the case of progressive concerns.

In regard to the former, Mr. Fedden gives it as his opinion that

> the continuity of the chairman and principal members of committees is essential to the successful development and well-being of the department, particularly so in the case of an electric supply, where the intricacies of working cannot be grasped in a short time, but can only be gained gradually by actual experience.

Further, that

> the committee is largely guided by its chairman and those members who act as chairmen of sub-committees, for the simple reason that by virtue of their offices they have familiarised themselves with the details of the administration of the department in a much greater degree than the other members of the committee are able to, and are, therefore, better able to explain matters relating to the working of the department and advise the committee accordingly. Under existing arrangements there is always the risk that the policy of the department may be interrupted by a change of party in power.

The next point touched on is division of management in electric supply departments. Mr. Fedden believes in "an engineer who is qualified by temperament, education and

experience, to watch and foster its commercial development, whilst well able to carry forward the engineering work and deal with problems of supply."

If such men were the rule, instead of the exception, one would be inclined to support him; but the average manager (let him be a trained engineer, by all means) will find himself so far occupied with commercial questions as to exclude the possibility of much else, if he elects to make his undertaking a live concern.

Furthermore, present day electrical engineering is becoming almost standardised, and no difficulty is experienced in efficient production, but the problem of profitably disposing of electrical energy in paying quantities still remains; we venture to think that it will only be solved by devoting far greater attention than hitherto to commercial matters. Mr. Fedden asks whether the engineer cannot approach the problem of disposing of his energy in his own way, as he has done in the case of other problems in the past? We are afraid that, judged by his past labours in this direction, the municipal engineer, as a rule, does not inspire confidence. Other points touched on by Mr. Fedden are Local Government Board procedure and reserve funds.

In regard to the former, he says :—

> The Inspectors of the Board who conduct the local inquiries which follow our application for permission to borrow appear to be vested with very comprehensive powers, and in certain cases have employed them with so much zeal as to suggest a desire to restrict the expenditure of public money in such undertakings, and have also shown a disposition to criticise the manner in which the undertakings were being developed, and the cost of works done, questions, in my opinion, solely for the local authorities themselves.

Presumably he holds that the local authority should be subject to no superior power, but should be allowed to spend the ratepayers' money *ad lib.*

In the case of reserve funds he suggests, very justifiably, that :—

> After a suitable reserve fund has been accumulated to deal with premature antiquation of plant and unforeseen expenses, any surplus might be devoted to the benefit of the non-direct consumer by extension of network and street lighting, and to the benefit of the direct consumer by reduced tariff.

The address concludes with a reminder as to the new regulations, whereby all members of Council must retire at the annual general meeting.

Public Authorities Protection Act.

The case of the Westminster Electric Supply Corporation *v.* the London County Council, which was heard by his Honour Judge Woodfall on June 23rd, serves to illustrate the advantages accruing to a local authority which is protected by the Public Authorities Protection Act. It appears that when the Council were erecting a new fire station at Westminster, some concrete got into an inspection chamber in the pavement belonging to the defendants, causing a short circuit. The concrete was laid in February, 1906, but was not discovered until October, when there was a short circuit. The short circuit did damage, which the plaintiff company put right at their own expense. They subsequently sought to recover this expense from the Council.

When they made a claim upon the Council, they were met by the defence of the Public Authorities Protection Act, 1893. That measure provides that where any action is commenced in the United Kingdom against any person for any act done in, or execution of, any public duty or authority, or any alleged neglect or default in the execution of any such duty, the Act shall not lie, unless it is commenced within six months next after the act, neglect or default complained of, or in case of a continuance of injury or damage within six months next after the ceasing thereof.

It seems that, when the claim was first made, the plaintiffs were asked to wait until the matter could be considered by the Fire Brigade Committee, and in the result, proceedings were not commenced until after the six months. It was argued that, inasmuch as the delay was caused in this way, the Council had waived their right to rely upon the Act as a defence. The Judge held that there was no contract by the defendants to waive their rights under the Act, and that, if there had been, they had no right to enter into such a contract, because, as a public body, they could not waive the rights of the ratepayers, for whom they are trustees. In the event, he dismissed the action. There can be no doubt that the point raised is one of great public importance. It is manifest that, if the plaintiffs had known that, by forbearing to sue and waiting until the Fire Brigade Committee could consider the matter, they were waiving their rights, they would never have delayed the issue of their writ. The case should put everyone who has dealings with a local authority on his guard. It often happens that a question of liability has to be brought before a particular committee which does not meet every day. Those who have any claim to make against a local body should be careful not to prolong negotiations in such a way as to deprive themselves of their remedy by action. We shall be interested to watch the further progress of this case in order to see whether it is competent for a local authority to waive its rights under the Act.

Inventing as a Business.

Mr. G. E. Stratton discusses this subject in an interesting article in the *Engineering Magazine*. The modern tendency, he says, is to keep the inventor inventing by affording him fair rewards for his genius, and to place the exploitation of his inventions in the hands of trained and skilled business managers. Mr. Edison is mentioned as the ideal professional inventor. He has invented always; he has never been a manufacturer. Mr. Edison's maxim as applied to all new problems is "If it can be done, is it worth anything?" and it is a valuable maxim which should be inscribed in the laboratories of all inventors. It appears from Mr. Stratton's article that, in addition to the class of geniuses to which the wizard of Menlo Park belongs, there is a class of humbler inventors in American workshops "who are engaged under salary to invent and develop improvements in the articles manufactured—to meet the demands for new articles, and to devise new methods of manufacture." These men play a very useful part in great manufacturing workshops. We doubt whether inventing in the highest sense can be made a business to be learnt by anybody. Inventors are born, not made. Our own country is not lacking in the divine inspiration, if we are to judge by the number of patents applied for; a different conclusion might be arrived at if we were to judge by the quality. America appears to be the special breeding ground of the inventor. The peculiar mixture of all races in that fortunate land appears to have produced a kind of superman who alone is capable of creating such diabolical inventions as the cash register, and the automatic telephone exchange.

Common or Proper?

The case reported in our Legal columns, which was decided by Mr. Justice Warrington last week, possesses literally a nominal interest, though it turned upon an important principle. The question was whether the word "Electromobile" was a common or proper noun; whether the plaintiff company possessed the sole right to its use, in connection with their own vehicles; and whether a word coined to designate a species of vehicle in the generic sense could become, by common usage, restricted to a particular type of that species. The judge decided in favour of the defendants, without calling upon them to produce evidence in support of their case; and we cannot conceive of any other rational conclusion being reached. The word "electromobile" has been in use

since the very commencement of the century to denote a motor-car propelled by electricity—especially a self-contained vehicle, as distinguished from one deriving its motive power from a distant source. Long before the Electromobile Co. came into existence this was the case. Curiously enough, one of the principal witnesses for the plaintiff company had himself used the word in its generic sense in a public lecture, reported in the ELECTRICAL REVIEW at the time, the company not then being in existence; and up to the present day the word is in actual use in the generic sense. To claim the exclusive use of the word is as absurd as to set up a claim to the sole right to use the word electro-motor.

Mr. Justice Warrington took occasion to stigmatise the word as "barbarous;" that is a matter of taste, so far as the sound is concerned; hybrid it is, no doubt, but not more so than "auto-car" or "automobile," and, to our mind, it is no more offensive than these, which are firmly established in the language.

London's Electricity Supply.

THE views expressed by the President of the Board of Trade, with respect to the advisability of municipal authorities leaving undertakings of a speculative character to be developed by private enterprise, are none the less welcome because their enunciation by a member of the present Government was unexpected. May we suggest into practice by giving the Electric Supply Bill promoted by to Mr. Lloyd-George that he might now well put precept the London companies a second reading, and subsequent reference to Committee for examination on its merits?

For it must not be forgotten that, although the Committee threw out the L.C.C. Bill on Wednesday last, there is this very important Bill yet to be considered. It is promoted by the London Electric Supply Companies with a view to obtaining powers to link up and develop certain of their existing stations for the purpose of not only increasing their output, but also, by decreasing the cost of generation and transmission, enabling them to supply current in bulk, and for power, at prices which would put them in a position to carry out, in effect, but at a less capital expenditure, what was proposed by the L.C.C.

The Council (apparently, for no reasons for rejection have yet been stated) failed, not because their proposals were not in accordance with the recommendations of the Select Committee of last year, but rather because they made an honest and determined endeavour to carry into effect the wishes of the London electorate, as clearly expressed in March last.

It is to be hoped that the Companies' Bill may meet a better fate, and that, at any rate, in logical pursuance of the views as to the encouragement of private enterprise which he put forward last Saturday, Mr. Lloyd George will give the measure a second reading and send it to Committee for consideration on its merits, unhampered by any special "instruction," such as killed the Council's Bill.

The present L.C.C. recognised that an electric power scheme of any magnitude was too hazardous a matter for them to undertake, and they sought the necessary powers with the object of leasing them. But the transfer of these large powers into unsuitable hands might have had a seriously detrimental effect upon electrical undertakings generally. We are not alluding to any competitive effect upon the existing undertakings, but to an indirect effect that would have followed failure. The capital involved by the scheme was enormous, and we have no hesitation in saying that such an undertaking would require to be administered by men of great business capacity, and with practical up-to-date knowledge of the conditions and needs of electric supply in and around London, to give it any chance of obtaining a reasonable measure of success. As a matter of fact, we doubt whether the possibilities offered by the scheme were sufficient to tempt those best fitted by experience to deal with the matter, to take it over on such terms as the present Parliament would sanction, and there was, therefore, the danger that the undertaking might have been acquired by people who, while financially quite able to carry out the Council's proposals, might fail—either entirely or to a great extent—to carry the enterprise to a commercially successful issue.

THE ENGINEERING CONFERENCE.

(*Continued from page* 993.)

Electric Transmission-Gears on Motor Vehicles.

CONSIDERABLE attention is now being paid to what are commonly called petrol-electric systems, which are systems in which a petrol engine is used as the source of power, the energy being transmitted to the road wheels of the vehicle by electrical means.

A discussion on this subject took place on Wednesday, the 19th inst., in Section VII. (Applications of Electricity). In his short paper introducing the subject, Mr. A. A. Campbell Swinton refers to the mechanical change-speed devices now in vogue as somewhat barbarous and crude.

Apart from the mere transmission of the motion from the engine to the road wheels he gives the following as the chief requirements:—

1. "An easily operated and preferably automatic variability of gear ratio, so that full advantage may be taken of the maximum effort of which the engine is capable without over-running in obtaining the highest possible acceleration and speed for the vehicle under varying conditions of gradient, load, and surface and other resistances."

2. "Perfect control of the speed of the vehicle under different conditions beyond the variations of which the petrol engine is capable."

3. "Ready disconnection of the engine from the road wheels, so that the former can continue to run while the latter are at rest, coupled with means for gradual reconnection so that the vehicle may start smoothly and without shock."

In comparing electrical and mechanical methods consideration must be given to ease of working, reliability, and freedom from breakdown and derangement, weight, efficiency in terms of the power lost in the transmission, first cost, cost of up-keep, quietness and freedom from vibration.

The author then proceeds to describe in general terms the fundamental principles of the various systems of electrical transmission which have so far been attempted. These are as follows:—

1. The engine, which is preferably fitted with a governor, drives a dynamo which supplies energy to an electric motor, which in turn drives the road wheels through the usual mechanical differential gear. An electrical controller of some description is fitted so that the electric current can be varied to regulate the speed of the motor, while, either by means of the controller or automatically by special windings on the dynamo and motor, the full power of the engine at its most efficient speed can be employed to generate constant watts made up of either a large current at low voltage, such as is required for starting and on steep gradients, or a small current at a higher voltage for running the vehicle at high speed on the level, with corresponding variations under intermediate conditions.

2. Similar to No. 1, excepting that the axes of the dynamo and motor being arranged in line, a clutch of some description is arranged between them, so that at top speed they can be mechanically dispensed with, the armatures of dynamo and motor acting merely as fly-wheels. In this arrangement the electrical drive is only employed for starting, and at other times when the power of the engine is insufficient to propel the car on the direct drive.

3. The engine drives a dynamo as in the previous cases, but instead of one motor, two or more are employed, each driving a separate wheel. The mechanical differential is thus dispensed with, but the direct drive, as in No. 2, cannot be arranged for. The two or more motors can either be arranged in the hubs of the wheels, when all gearing is dispensed with, or can drive the wheels through chain or toothed-wheel reduction gear. The latter are the arrangements usually employed; as, unless some form of speed reduction is used, the motors are of necessity relatively very heavy. The employment of two or more motors enables the series-parallel system of control, so much used on electric tramcars and trains, to be adopted.

4. A storage battery of comparatively small capacity, but capable of giving large discharges for short intervals, can be employed with any of the above-mentioned systems, the arrangement being such that, for starting or on hills, the

battery discharges and assists the engine and dynamo in driving the motors, while at other times a part of the power of the engine is absorbed in charging the battery, the change being automatically effected by the relative voltage of the dynamo on the one hand, and of the battery on the other.

5. In another method, in which a storage battery is used to assist the engine when required, there are no separate dynamo and motors, but on the shaft of a mechanical transmission is fixed the armature of a machine, which performs the function of both dynamo and motor as required, automatically charging the battery when the engine has power to spare and the speed increases, and taking a discharge from the battery and acting as a motor, so as to assist the engine when the latter becomes overloaded and the speed diminishes.

It was pointed out that in those systems which employ auxiliary batteries there is an advantage in that the engine can be stopped when the vehicle is at rest, and may be started up by means of the battery when required. A battery can, of course, be used only with a continuous-current system, and reference was made to the use of polyphase and alternating currents which at present are being tried with some measure of success.

The author considers the chief scope for electric transmission on motor vehicles to be on heavy vehicles such as motor-omnibuses and the like, and on large motor-coaches on rails, such as several of the railway companies are now running on suburban lines.

DISCUSSION.

Mr. HART (of Luton), who was called upon first by the chairman, stated that in developing the petrol-electric system which is now known as the Hart-Durtnall system, he started with continuous-current apparatus. Troubles due to brush gear, commutators, sparking, &c., soon convinced him that for service on rough roads the continuous-current system was handicapped by very considerable disadvantages. Attention was then turned to polyphase working, and the system which had recently been described in technical papers was developed, in which the only continuous-current apparatus was the small exciter necessary for energising the fields of the three-phase alternator. The advantages of this system as compared with the continuous-current were that the equipment was lighter, more robust, and cheaper. As regards cost of running, Mr. Hart stated that the petrol-electric system which he advocated could beat any ordinary petrol-geared 'bus. On a demonstration 'bus which had been equipped on the Hart-Durtnall system, the consumption was at the rate of 1 gallon of petrol to 6½ miles. This figure, however, formed no basis of comparison with any other vehicle, as the conditions under which the trials were made were not given.

Mr. STEVENS, of Maidstone, then described the continuous-current system which he has developed, and which he prefers to the alternating system. In the system he has adopted, a petrol engine is coupled direct to a dynamo, which is fitted with auxiliary poles and designed to give as nearly as possible constant watt output, the current varying inversely with the voltage. For 'bus work a motor is worm-geared up to each of the back wheels, the worm-gear being fixed outside, where everything is quite accessible. The armature of the generator is double wound, and fitted with two commutators, and the controller is arranged so that the commutators, both of the motors and of the generator, can be put in series or parallel as desired, so as to obtain various speeds. By this means four speeds are obtained without the use of any resistances. The only difference we noted between Mr. Stevens's description and that which has already been published, is that an automatic switch is fixed under and operated by the seat, so arranged that the circuit can only be completed when the driver is seated thereon. This prevents the possibility of starting the car by starting the engine when the controller is in one of the running positions.

Mr. MATTHEWS gave some information as to what had been done on some of the American railway lines in the direction of using motor-cars for shunting purposes, the most interesting point in his remarks being that the English-made Wolseley engine, notwithstanding that it was more complicated than American engines, had proved more satisfactory.

Mr. MAVOR sketched on the blackboard a method which, so far as we could make out, was on the lines of the method patented by Jenatzy a few years ago, in which a magnet system coupled to the engine was revolved round a closed-circuit armature. The description, however, given by Mr. Mavor was not at all clear, and we could not understand how he reversed his direction of rotation and obtained various speeds.

Mr. MORDEY pointed out the fact, to which attention has previously been drawn, that the pioneer of all these mixed systems was the Heilmann locomotive, and referred his hearers to a paper read by himself and Mr. Jenkin before the Institution of Civil Engineers a few years ago. This paper had, of course, nothing at all to do with petrol-electric transmission on road vehicles, and descriptions of the Heilmann locomotive are to be found in back numbers of most of the technical papers.

Mr. BERNARD HOPPS described the principal features of the B.T.-H. petrol-electric system, a full description of which has previously appeared in our columns. His objection to the direct drive, which is a prominent feature in the Hart-Durtnall system, was the necessity of perfect alignment between the engine and generator and the gear between propeller-shaft and driving-axle, and also the limited speed of the engine. With electric transmission the engine and motor speeds need, of course, not be the same. On the question of fuel consumption he gave records of a run of 260 miles at an average of 14·6 miles per hour, the consumption being 1 gallon per 8 miles, and the total weight of vehicle and passengers being 5 tons. As already pointed out, this forms no basis of comparison with runs in which there is very frequent starting and stopping, such as is experienced in ordinary 'bus work in the streets of London.

Col. CROMPTON (Chairman) said that all electrical engineers had so appreciated the enormous advantages of electrical driving that they looked with considerable interest and hopefulness on the introduction of electrical transmission on road vehicles. Owing to the large number of men employed in work pertaining to locomotion, the introduction of electrical methods meant a great deal to electrical engineers. Whilst the results of the experiments which had so far been carried out were most promising, yet it was most important to guard against putting too much upon the motor drivers and mechanics. They must not, for instance, expect them to learn all about electricity, and things must be simplified as much as ever possible. This at once, therefore, ruled accumulators out of the question for the present. From the point of view of economy and lightening the equipment, and for fewness of parts, he thought the No. 2 proposal in the paper, namely, the one in which electric driving was only used for starting and accelerating the car, and direct driving for running, appeared to be the best.

Water Softening.

Mr. Wm. Matthews' paper on "Water Softening" (Section VI.—Waterworks. Wednesday, June 19th), was rather of the nature of a concise record than a description of a novel remedy for a long-existing difficulty. Records of this kind are eminently useful to the profession as affording a handy reference on the subject without the laborious research which the compiler of such a paper must necessarily undertake.

The author confined himself to a description of the process of water softening by lime, and did not deal with any of the patent processes for the purpose, probably for the good reason that the majority of these are based on the use of the same simple ingredient. He commences by stating that temporary hardness, due to carbonate of lime and magnesia, can be removed by the addition of lime to the water. "Ordinary builder's lime is useless for the purpose; it must be hard burned, and practically free from alumina and siliceous matter, and the lime obtained from chalk, if at all of a marly character, must be studiously avoided." It is such particulars as these which are valuable to the practical man.

Mr. Matthews goes on to describe the process of formation of "cream" of lime, and states that the mixture is best accomplished by allowing the lime water to fall in a thin sheet over a similar sheet of hard water. Precipitation is thus accomplished, as in the process of sewage treatment by lime (modestly called "milk" of lime), and the water is finally clarified by allowing it to pass through cotton cloth mounted on wood frames. The cleansing of the cloth is best done by tangential water-spray.

DISCUSSION.

In his concluding remarks, Mr. MATTHEWS said that to ensure successful results, care must be exercised to prevent hardened water being used in the preparation of the reagents. If this mistake was made, carbonate of lime was formed there and then, and the chemical reaction was consequently hindered. Another point to be remembered was that in the apparatus a certain amount of carbonate of lime was continually precipitated. If this was neglected the deposit in the tanks would seriously reduce their accommodation. He knew a case where the deposit in a 5-ft. tank was found to be no less than 2 ft. 6 in. deep. The Haines system was mostly in use. At Southampton they were passing 4 million gallons a day through a space which he thought would astonish most people who saw it.

Mr. BALDWIN LATHAM had a Haines apparatus treating 2 million gallons per day. The space required for one of the big tanks necessary for the Clark system provided not only accommodation for the apparatus, but storage room as well.

Mr. Hawksley, from personal inspection of the Southampton installation, confirmed the excellent report of the Haines system.

Several other speakers dealt with the question from the water supply standpoint, and Mr. Matthews replied shortly. Dealing with a question, he said that the Archbutt-Deeley process was the only one which could properly deal with softening if a reagent other than lime, had to be employed. The cost at Southampton was ·33d. per 1,000 gallons. The total cost of the Clark system would not be far under 1d. per 1,000 gallons, whilst the Archbutt-Deeley process would be about ¾d. and the Atkins ½d. per 1,000 gallons.

Up-keep Charges on Large Electric Generating Sets.

By Messrs. J. Burstall and J. S. Highfield (Section VII.—Applications of Electricity. Wednesday, June 19th).—The whole point of the paper is to protest against the custom of reckoning repairs and maintenance *per unit generated*, whereas but a very small part thereof consists of charges proportional to the load, namely, material and wages for renewals of parts, such as piston rings, packings, bushes, brasses, &c., and dynamo brushes; the other charges varying with the *capacity* of the plant, not with its use. This point is considered in detail as regards the several parts of the plant, generators and prime movers, whether steam engines, gas engines or turbines, &c.

The value of the paper lies in the application of the results obtained. No mention is made in the paper as to the purpose to which the separation of running and standing costs of repairs and maintenance is to be applied. We take it that the true value of such a practice as is suggested would be found in fixing an annual rental per kilowatt of power supplied, which should include the profit to the undertaking, and to ascertain the price per unit of energy, which should be sold at the true running cost. Where the charge made for supply is upon this basis, it is absolutely necessary to follow out a system on lines similar to those suggested by the authors, in regard not only to generating sets, but to the whole of the costs upon the undertaking. Coal, water and engine stores are primary running costs, to which must be added a portion of station maintenance and distribution charges, and if the object of the paper is fulfilled and a definite system laid down for separating the charges named, the result will be welcomed by all engineers of large power supply undertakings.

We do not agree with the authors in stating that repairs and maintenance of mains and switchboards may be taken as sensibly the same in most large systems. It is often necessary to use one particular feeder in a greater measure than another, as it is impossible, in laying down a distributing system, to forecast accurately the particular feeder upon which the greatest demand will be made; therefore a system that is fairly well balanced will be subject to less maintenance charges than one that is overloaded in one direction and lightly loaded in another. The actual repairs to mains and materials used in distributing stations should be considered under running costs, and the periodical inspection of street boxes, &c., and wages at distributing stations considered as standing charges. General repairs to switchboards should be a negligible quantity, and therefore chargeable to running costs, as it is impossible to fix an annual sum for the up-keep. When, as sometimes occurs, it is found advisable to reconstruct a switchboard, it is preferable to draw upon reserve fund for the cost.

In dealing with station maintenance, it is quite practical to fix an annual sum for the overhaul and inspection of buildings, engines and boilers, which would constitute a standing charge, leaving, as suggested by the authors, in the case of engines, &c., material and wages for renewal of parts (piston rings, packings, bushes, brasses, &c., and dynamo brushes), and in the case of buildings and boilers, the wages and materials required to make good the wear and tear upon the same.

We do not think it would be in any way difficult to arrive at a definite conclusion, in drawing a line of demarcation between running and standing maintenance costs, if it be assumed that all charges which can be fairly accurately estimated at the beginning of any financial year, are standing charges, and those which occur from time to time, and are entirely dependent upon the demand upon the system, are running costs.

It appears to us that the whole question is one of accountancy rather than of engineering, but because of that it should not be lightly dismissed, and upon the whole we think that the paper shows the absolute necessity for a standard and accurate method of cost keeping, which would materially assist the progress of all electricity undertakings.

Discussion.

Mr. W. W. Lackie (Glasgow) opened the discussion, pointing out that the number of men employed on a station was not proportionate to the size of the station or the capacity of the plant.

Mr. Ll. B. Atkinson said that it was not in accordance with his experience that a large staff of men should be kept in readiness for emergency in case of breakdown. It ought to suffice to be able to call on the staff of the insurance office. The relation between the units generated and the kilowatt capacity of the plant was variable and depended on the load factor. Repairs might depend partly on the revolutions of the engine, partly on the number of years it had been in existence independently of the work it had done.

Mr. J. Bell thought that the personal equation of the repairing staff had a good deal to do with the up-keep charges. He had known the cost to come down on getting another class of fitter. He was in favour of having a regular, but small, repair staff, which would take interest in the work, and in making repairs would also make improvements, so that the trouble would be unlikely to recur.

Mr. A. Goodwin cited his experience with a 750-kw. turbine, which had been at work for alternate weeks for 2½ years, running continuously for a week at a time without attention and without any expense for repairs.

Col. Crompton (Chairman) agreed with Mr. Bell that much depended on the foreman fitter. At Chelmsford he could show an old-fashioned power plant still maintained in good order, because the fitter knew all the tricks of every part of it. The cost was nothing but the fitter's wages and a few pounds for material. From the engineer's point of view the returns of companies and local authorities were quite untrustworthy. From the assessment point of view they took no account of appreciation, or betterment of plant, due to repairs. Cost of up-keep was high in Calcutta, not only because climate and thunderstorms damaged the insulation, but the climatic conditions rendered the men unfit to look properly after their work. It was much the same as the stoke-hold of a steamer in the Red Sea. The cost of repairs included that of opening up and breaking joints for examination of machinery, compared to which the actual sum spent on repairs themselves was infinitesimal.

Mr. Burstall, in replying, remarked on the difficulty of getting definite figures respecting repairs and maintenance. They differed greatly according as the stations were for lighting only or mixed lighting and power stations. But the standing charges under this head were always quite out of proportion to the running charges. Thus, at Deptford, the cost per unit for repairs on certain machines remained constant for some years. When it chanced that the machines were less used, the cost went up enormously; not that the repairs were any more, but the units generated were fewer.

The Application of Electricity to the Working of Railway Points and Signals.

By Mr. L. M. G. Ferreira (Section VII.—Applications of Electricity. Wednesday, June 19th).—The author opens with a list of indispensable conditions in signalling, whereof the most important perhaps are immunity from breakdown and the setting of the signal at danger in case of any failure in any part of the gear. The main questions of detail dealt with are those of solenoids *v.* motors, the author decidedly preferring the latter, and return indication currents. Mr. Ferreira thinks that prime cost is the chief cause of the hesitation in adopting electrical working, and, at the end of his paper, he intimates that he has recently designed a system which will meet all the essential conditions, and which will cost little if any more to install than the usual mechanical signalling plant. With regard to this matter, he points out the saving of space in replacing rods and signal wires by cables, and the further economy in maintenance.

The paper is thoughtful in tone, and is itself evidence of the author's acquaintance with his subject. Justification of the use of power in place of manual labour, for the operation of points and signals, is easy for places where the means of actuation of large numbers are assembled together as is the case at large stations, busy junctions, or large marshalling sidings. The question is not entirely one

in which the signalman alone is concerned, although bodily fatigue, such as follows from the working of heavy points and signals for a number of hours, has its own deleterious effect. The principal point is the greater facility that is given for carrying out the numerous operations for dealing with traffic without delay. The necessity for the assemblage of a large number of levers at one point renders the lengths of the frames inconveniently great, and valuable time is lost in passing to and fro between the levers concerned in any one movement, the operation of which has necessarily to be made in a prescribed order. Where power is used for the direct operation of the apparatus, the levers in the box become, practically, switches by which the power is put into operation, instead of being, as in the manual system of operation, the actual means of transmission. They, therefore, partake of a different character, of a minor importance, and their sizes and arrangement may be varied in accordance with the new conditions. Hence it is found that great economy of space may be effected, as the levers and their travel are very small, and they may be placed much closer together than in the older form ; they can also be arranged in tiers and further economy of space obtained. This, again, results in the travel necessary to complete any movement being reduced and time being saved accordingly. When to this advantage is added the diminished muscular force required to bring the power into operation, the increased speed and ease of operation may be readily inferred.

Granting the advantages of operation by power, the character of the power employed becomes important. Practically, only electricity and compressed air are capable of being pressed into this service, and the latter, where it is actually the means of actuation, must be aided by the former as a means of control. As Mr. Ferreira says, the necessity for the use of a second source of power does not seem very obvious when the first is capable of performing all the requisite operations. It must, however, be remembered that pneumatic systems were first in the field, and have very powerful backing ; and this, together with the natural caution and conservatism of engineers as a rule, has tended to retard to some extent the inevitable extension of electric power for this purpose. It is lamentable to see the duplication of apparatus installed on many occasions. We have in mind a case where gas engines and dynamos were put down in duplicate to charge accumulators, also in duplicate, for supplying current for the control of an electro-pneumatic system of signalling, and, in addition, electric motors operated from local supply mains were installed for driving dynamos as a further stand-by. Besides this, it is suggested that a further security against breakdown would be afforded by arranging for the local supply to be available direct, notwithstanding the fact that the pressure so available is five or six times that used on the original installation ; and all this has been arranged in a neighbourhood where the local supply mains are everywhere available, and where the annual consumption of electricity in the immediate neighbourhood is reckoned in millions of units.

In another case, where an all-electric system is in use, supply is taken from local mains at the standard pressure, without batteries or other form of reserve, and supply has been maintained without failure for over three years. The instance in question comprises 80 or 90 levers, and the ascertained consumption during 1906 was an average of 386 units per month, the cost of which, at the average cost per unit of the installation, was about £1 12s., and the total annual cost for power was, therefore, only about £20. If this cost is contrasted with that of installations where alternative supplies have been sought to such an extraordinary extent, involving as they do not only additional charges for the capital expended, but additional labour charges, the comparison cannot fail to be instructive. As Mr. Ferreira says, the hesitancy in adopting electrical operation has, no doubt, been due to the comparatively high first cost ; but it is more than doubtful whether that cost has not been due to an exaggerated fear of failure of the electrical equipment, which derives its origin from a want of experience with such apparatus.

Makers of electrical apparatus for the operation of points and signals will greatly facilitate the disposal of their wares if they will more readily adapt themselves to existing conditions, rather than expect those conditions to be modified to suit their requirements. If they make their apparatus for use on a standard pressure, and demur at a request to adapt their wares to any other pressure, it follows that even if such apparatus is adopted, the costs of operation are necessarily increased, and the system will labour under a serious disadvantage. Electrical supply is now available at almost every large railway centre under certain conditions for use, and if railway companies can obtain such supplies at a reasonable cost without the expenditure of capital on generating plant, they are much more likely to use electric power for such purposes as form the basis of Mr. Ferreira's paper. It lies with the makers of such apparatus to adapt it to the means available at the points at which they wish it to be installed, without additional cost to their customers. In other words, it is to the advantage of both the makers of such apparatus and to the railway company as users, that the capital expenditure and maintenance costs to be incurred by the latter in any proposed installation shall be a minimum. Any neglect of this principle will re-act prejudicially on both parties, but principally on the makers.

The day of the small isolated specially-arranged generating station is past or nearly so, and equally so is the time for suspicion of the reliability of electrical supply from an outside source. If it is not, then the case of large power users who are now taking supply from central sources having outputs of from 20 to 60 million units per annum is parlous indeed. The immunity from breakdown in connection with the supply for electric traction on converted railways is a curious practical commentary upon the provision of so many alternative sources of supply for what is, after all, a subsidiary part of railway work.

Some part of the distrust of the reliability of electrical supply exhibited by the provision of alternative means for use in case of failure, may be traced to other causes. It must not be forgotten that the quality of the work done on site is of the utmost importance in ensuring against failures which, whilst only partial, are almost as irritating as total failures ; to those who have noticed the way in which such work has been done in some instances in the past, the wonder is not that failures take place, but that they are not of more frequent occurrence. The way in which cables and wires are sometimes laid and handled, or treated after laying, would be a nightmare to electrical engineers accustomed to think of the insulation resistances of cables and wires in megohms.

Discussion.

Mr. Malan, while agreeing with the author in his preference for electrical over manual methods, advocated the electro-pneumatic system, in which electricity merely controlled the valves, and the work was done by compressed air. Therefore the currents were quite small, about 75 milliamperes, and the pressure only 12 volts. There was some loss of energy in worm gear through wear and tear, and it would be necessary to put a clutch between the electric motor and its work to provide for such a contingency as a stone between the points, while with pneumatic power there was no such necessity. He was at one with the author in condemning solenoids. The position of the lever should always correspond with that of the mechanism moving the points. That was easily attained on the electro-pneumatic system, owing to check locking, but not on the electric system.

Mr. Blackall (G.W. Railway) had experimented with power systems of signalling. He talked it over with the manager, and they decided in favour of a purely electric system. Already electric power was available, and they had but "to turn on the tap to use what they had got." Practically they had had no failures, and the cost of maintenance was small. At the same time he maintained that the conditions laid down by the author were fulfilled by the manual system. He found that electric working was not beyond the grasp of an intelligent signalman, and check-locking could be applied either to the purely electric or to any other system.

Mr. Alex. Siemens contrasted Mr. Ferreira's system with the German one, as worked at Didcot and Derby. On this the position of the points was displayed by flags in the signal box. As Mr. Malan had said, it was requisite to be certain that the points had gone over, and any subsequent tampering with the points was not signalled in the cabin by the check-locking system. If there were a stone in the way, it could be made to drop out by moving the points to and fro, as easily on one plan as on another. There was also no difficulty with an electric motor in increasing the power, say, on a frosty morning, as suggested by Mr. Malan. Electricity was the most adaptable of all forms of power ; and, applying the £. s. d.

test, it was the best because cheapest, when maintenance as well as first cost was considered.

Mr. B. H. Peter had experience only of the electro-pneumatic system. He understood that on the purely electric system the wear and tear were very great. On the other hand, the electro-pneumatic motors on the District would work day and night for over two years, making some 400,000 movements, and require no attention beyond occasional oiling, and perhaps a new piston leather, which could be put in in about twenty minutes at no appreciable cost. The rectilinear push and pull of these motors was better suited to the work than the rotatory movement of an electric motor.

Mr. J. P. Annett (L. & S.W.R.) had no experience of electrical work. On his line the electro-pneumatic system (low pressure) was employed. They had few failures, and found it satisfactory, but more costly than the manual system.

Mr. Jacomb Hood said that it seemed an anomaly to use two systems where one would suffice. In the long run they would all come to electric working. He described one way of getting rectilinear motion from a motor. The motor was used to drive a pump which pumped oil into one or the other end of a cylinder fitted with a piston. The real trouble was with stray currents; Mr. Ferreira's plan of earthing all dead leads seemed to him effective, but dangerous. Continuing, Mr. Jacomb Hood was questioning the cheapness of electric signalling as compared with manual, when Mr. Siemens offered to take any orders at the price of the manual system.

Mr. Morgan (Sykes' Interlocking Signals) said that his company had check-locks on the levers, by which means it was easier to find which lever was in fault. He agreed with Mr. Siemens that the permanent indication was also desirable. The pneumatic system must be handled very carefully or there would be trouble with frozen pipes. The cost of maintenance on his system came out at 2s. a week for 257 levers worked from one set of accumulators.

Mr. H. B. Holt (Midland Railway) said the Midland had had no failures except of "the kind you want"—*i.e.*, those which indicated faulty points. Nor had they had any trouble with stray currents, only with the automatic devices put in to prevent them. The control system was quicker to work than check-locking. His experience was in favour of solenoids; while as for motors and brushes, he had not had to change a brush in 2½ years' working.

Mr. Thomas Parker remarked on the conservatism of railway engineers. He was glad to see them at last taking this matter up, but progress was extremely slow. There must be some better way than the heavy labour imposed on signalmen by the manual system.

Mr. Ferreira, in reply, explained that the movement of points involved two rectilinear motions alternately, one to withdraw the locking bar, the other to reverse the points. There was no more difficulty in reversing by a motor than by an air cylinder. The Continental practice was quite different; the points were moved over, say, 4 in., and the locking was done by a further movement of the outer point, which was not connected with the inner by a coupling rod, as here. With regard to the "frosty morning" difficulty, the electric plan had the advantage. They could not increase the force on an air piston without first raising the pressure of the compressed air, but an electric motor rose to the occasion, running more slowly, but exerting greater torque. There was no danger in earthing the leads not in use. He had tested some half-million contacts, and had not found one failure.

(To be continued.)

PARLIAMENTARY.

London County Council Electric Supply Bill.

On Tuesday, June 18th, Mr. J. H. Rider, examined by Mr. Clode, said he had been electrical engineer to the L.C.C. tramways, and described in detail the various electric lighting undertakings in London, and said that, in his opinion, London needed some large and comprehensive scheme for dealing with this question adequately. The first, and probably the most important point in such a scheme, was that large generating stations should be obtained situated on sites where there was water carriage for coal and a large amount of water available for condensing purposes. Except in a very few instances all the stations in London failed in those two fundamental requirements for the production of electricity on a large and cheap scale.

Therefore what would you insist on if you are to provide a proper scheme for this area on the most economical scale?—In the first place, the site must be somewhere on the river Thames, where you get cheap carriage for coal and an abundant supply of water for condensing purposes. The station must be of large capacity in order that the operating expenses and other charges should be kept down to the lowest possible point. The generating units must be of a very large size, as it is necessary to keep the size of the building down as much as possible. The price charged must be a low one in order to encourage the use of electrical energy, and such a low cost of generation can only be obtained under the conditions named.

Continuing, Mr. Rider said that the success of any scheme would depend upon securing a diversity in load factor, and in the proposed area covered by the Bill they had secured that diversity, because they not only had the ordinary lighting load to look forward to, but there was also a large power-load which was bound to develop in certain parts, and in other districts where the power-load would probably not be developed much, they had a lighting load to fill up the hollows in the stations. He believed there was a very good prospect of the Council, or its lessees, obtaining a large custom, and that they would be able to get railways and tramways to take a supply. The Council had decided to supply its own tramways itself, but there were a large number of tramways in the outskirts, which could be well supplied under the scheme.

What do you say as to the demand for power for manufacturing purposes?—I think at the present time there is, or would be a large demand for electrical power if a supply could be given that was not only cheap, but of the right kind suitable for motors. He had no doubt, continued witness, that many of the existing forms of energy would be given up in favour of electricity. In his opinion, the scheme as laid before the Committee on behalf of the L.C.C. in all respects met the requirements to which he had referred—the production of electrical energy cheaply, and on a large scale. To some extent power was now supplied by existing undertakers to manufacturers at the cost of people who only used electricity for lighting purposes. The area of supply covered a total of 451 square miles, 117 of which were inside the County of London, and 334 in outside districts. Witness then described the proposed generating station at Barking. The site, he said, was an excellent one, because it fulfilled the two principal conditions which he considered essential to the success of the scheme, *i.e.*, it afforded water carriage for coal and water for condensing purposes. There was plenty of spare land adjacent for extension purposes if required. The generating plant would consist of 10 steam turbo-generators of a rated capacity of 120,000 KW., but capable of working up to 150,000 KW. as an overload capacity. Coal would be brought up by steamers, for which there was plenty of accommodation, and a pier would be provided which would allow of two steamers, carrying about 2,500 tons each, to lie alongside at the same time. The plant was designed on the most modern lines, and would be of the best possible construction, so as to ensure a reliable supply. The estimated cost of the station per kilowatt of rated capacity was £12 2s. 6d., which included engineering expenses. On the overload capacity, the cost per KW. was estimated at £9 81. Power was taken in the Bill to secure land at Erith for the erection of another generating station, should it be wanted in the future. There were to be 13 control stations in the County of London area, and eight outside. From Barking the energy would be taken direct and independently to each of those stations. The estimates provided for two independent trunk mains from Barking, and the control stations were connected together by interconnected cables between the stations. In addition to trunk and interconnecting cables, there were branch cables going from the control stations to the authorised distributors.

On the subject of the maximum charges authorised in the Bill, Mr. Rider said it was proposed to give three kinds of supply—one of the same pressure as it could be generated from Barking—that would be called extra high pressure untransformed, leaving the consumer to do his own transforming. For that supply they had power to charge £3 15s. per annum per kilowatt plus 0·22d. per unit. The price for transformed alternating current was fixed at £4 7s. 6d. per annum per kilowatt plus 0·25d. per unit, and the third kind of supply to authorised distributors would be low pressure direct for which the maximum charge was £5 12s. 6d. per annum per kilowatt plus 0·27d. per unit. A slightly higher price was to be charged to power users who were not authorised distributors. The price went down very rapidly as the load factor increased. The charges he had mentioned were the maximum, but they estimated that they would be in a position to supply at 25 per cent. lower than the maximum. The estimate which had been prepared of the probable result when the Barking station was two-fifths completed and at work with a maximum load of 45,000 KW., showed that there would be a gross surplus available for depreciation, interest, &c, of £140,000. In those estimates they had assumed a station load factor of 35 per cent., and a consumers' load factor of 23·29 per cent. They had taken coal at 12s. per ton—a very high figure—to be on the safe side.

Witness then gave particulars regarding the statutory power of authorised distributors within the area, and of the generating stations owned by such. On the question of price, Mr. Rider said his tables showed that the price for private lighting varied enormously—from 2·40d. per unit in Bermondsey, to 5·604d. in Bexley. In the case of power and heating, Fulham and St. Pancras charged 1d. per unit on the average, while Stoke Newington charged 2·78d. There were similar variations in the price of public lighting, which varied from 1·22d. to 3·55d. in the case of Acton. Having referred to the capital expenditure by authorised distributors, witness next dealt with the cost of generation, and put in tables showing the cost to the present authorised distributors. He said the figures showed how much more costly it was to generate in a number of small local stations than it would be to generate and transmit to those stations from a large station outside. It would actually pay some of the stations to take the whole of their supply from the L.C.C. under this scheme, although they might have to add to the cost of the supply their existing capital charges. Taking Islington as an example, their working costs for the year were 1·06d. per unit, and that added to ·75d. per unit for capital charges, made a total of 1·81d. per unit. Had a supply been available under the present scheme, the resultant charge to Islington would have been only ·75d. per unit, and on the present sale that would mean a net saving of over £4,000 a year to the borough. They did not suggest that all existing stations should be shut up; in many cases it would be policy to continue to work them on one or two-day shifts. The only alternative to the present scheme for giving London a cheap and sufficient supply of electrical energy was for the stations of the existing undertakers to be increased. There was no doubt that in some cases increasing the existing stations would not only lessen the capital cost of those stations, but would also lessen the cost of production. His opinion, however, was that

the extension of existing stations—at any rate, the very large majority of them—would be a mistake, and that the result would not be to give such economy in working as would be obtained under the Council's scheme. Competition already existed in regard to bulk supply, and he thought that the additional competition which would result from the present Bill being passed was perfectly justified.

Dealing with the growth of the demand for electrical energy in the proposed area of supply, Mr. RIDER said his tables showed that from 1901 to 1906 there had been an increase of 129 per cent. in the maximum demand and of 176 per cent. in the number of Board of Trade units sold. It was estimated that there was at present within the area of supply something like 370,000 H.P. actually in use, made up of steam, gas, hydraulic, &c. He thought there was in the area a load sufficient to utilise about 80,000 KW. at the generating stations, in addition to the lighting requirements within the area. They had provided for 120,000 KW. of working plant, which would be capable of dealing with about 163,000 KW. of actual load.

Mr. WEDDERBURN, K.C., cross-examined Mr. RIDER on behalf of Shoreditch and Woolwich, and pressed him to say what would be the position of the undertakings in those localities, supposing the present scheme was at work.

The WITNESS replied that he should think they would continue to generate, and he would suggest that they use their works for two shifts. As to linking up the various London undertakings, he did not think it could be done with advantage. Linking up *per se* was a right policy, but the main point was that they must only link up where suitable. The stations in London were so diversified in the character of the supply they gave and, generally speaking, they were situated in an improper position for generating on a large scale, and therefore linking up would be wrong.

WEDNESDAY, JUNE 19th.

Mr. RIDER was cross-examined by Mr. MOON, K.C., on behalf of the associated companies who are opposing the Bill.

WITNESS said that they reckoned on getting 370,000 H.P.

Mr. MOON said that according to the census which had been made on behalf of the companies, the whole of the horse-power available and likely to be utilised in the companies' areas was 103,000, of which 45 per cent. was already being supplied by the companies.

Mr. FREEMAN, K.C., said that the L.C.C. estimate of 370,000 H.P. was made up as follows:—Inside the County of London, 293,887 H.P.; and outside areas, 77,113.

Questioned as to the assumed surplus of £431,000 on the working of the scheme, Mr. RIDER said that that represented a return of about 7 per cent. on the capital. Out of that it would be necessary to deduct 2¾ per cent. for depreciation, which would leave 4¼ per cent.

Mr. MOON: I put it to you that there is at present in the works of the companies in London 25,000 KW., which is installed and available for use; that there is 50,000-KW. capacity in buildings in which plant could be placed, and that there is 350,0000 additional KW. capacity on existing sites not at present utilised?

WITNESS replied that the sites were in the wrong positions, and not only would there be very great difficulties in obtaining the necessary amount of coal and water for condensing purposes, but they would become a nuisance to the neighbourhood. He estimated that the companies would take 25 per cent. of their supply from the transferree under this scheme—in some cases it would pay them to take the whole of their supply.

Mr. FREEMAN, on behalf of the promoters, read the new Clause 66A, which had been prepared at the request of the Committee; the leading provisions were given in our last issue (p. 1014).

THURSDAY, JUNE 20th.

The cross-examination of Mr. RIDER was continued.

Replying to Mr. WILLIAMS (representing Stepney Borough Council), WITNESS said he would enter into negotiations with the Borough Council for giving them a clause similar to that given them by the Administrative Co. last year if Stepney would agree to take a supply, but the terms would have to be discussed. He maintained that Stepney's total generating expenses for power supply were 1½d., and yet they were supplying at 1d., or slightly under. The linking up under the Bill was very different from the linking up proposed by the borough councils. Under that Bill it was proposed to link up with the one common source of supply at Barking with the various authorised distributors, but the proposal of the borough councils was to link up stations which were generating at different pressures, and which, generally, were quite unsuitable for linking up.

Answering Mr. SANDERS (for Islington Borough Council), WITNESS doubted whether Islington had the capacity on their present site for installing a further 40,000-KW. of plant. They might have space for 40,000 KW. of generators, but this took no account of boilers and other auxiliaries. Islington was one of those places with a poor load factor, and, in consequence, it would pay them to take the whole of their supply from the County Council and pay the charges on their existing capital, and even then supply at a lower price than they were now doing.

In re-examination, WITNESS said he regarded the Bill as co-operative and not competitive. There would be no need for the County Council to enter any district and supply the power user direct if the local authorised distributors did their duty and supplied at a price near to that offered by the Council. Clause 20, to which objection had been taken, was the ordinary stand-by clause which already existed in the provisional orders of many of the authorised distributors who were opposing the Bill. Clause 43A, to which objection had been taken, provided for the laying of mains, but there was a provision in the Bill for alternative routes by agreements with the road authorities. Generally speaking, all the matters raised in cross-examination had referred to alterations in small details, which did not make any difference whatever to the principle of the Bill. The whole basis of the Bill was cheap power supply, which, as he had repeatedly said, was at present impossible, owing to the conditions existing in the stations of authorised distributors, and the positions in which they were placed. With regard to the present powers which local authorities had of purchasing companies in London, he could not conceive a more complicated position. In many cases the undertakings of companies extended over several areas, which would mean that the local authorities would only in some cases be able to purchase the mains, and no generating station, and in other cases only the station, or part of one, and no mains. The point had been raised that the transferree could offer a very cheap supply in the areas of local distributors, and so compete with them until they had practically ruined the local authorities' undertaking; but in this connection the draft terms of the lease provided that no agreement could be made for any supply to a bulk consumer without the consent of the Board of Trade. It had also been suggested that the transferree could amalgamate with one company and so unfairly compete with another, when two were operating in the same district; but the way he read the Bill was that the only amalgamation which could take place was between authorised distributors. He regarded this scheme as unique, and a great scheme for London and surrounding districts.

Replying to members of the Committee, WITNESS said the present consumption of electrical energy in London was about 50 units per head of the population, and on the Continent and in America it was about 150 units. He did not look to so high a consumption in London as this, and estimated it to reach 100 units. The estimated coal consumption at Barking would be about 460,000 tons per annum, and it would be possible to generate a certain amount of electrical energy for half the consumption of coal now going on in London. He thought that any transferree would carry out the scheme on the lines submitted to the Committee. He was not familiar with the operations of raising capital by a company, but he knew that his figures of capital expenditure were on safe lines. His figures were prepared before the change of Council and change of policy, and to that extent had not taken into account any rent which the transferree might have to pay. He estimated that his figures, after paying for depreciation and sinking fund, would return 2¼ per cent. He agreed that certain local authorities who obtained provisional orders and passed them over to companies had had to re-purchase them at a high price.

On Tuesday Mr. H. F. PARSHALL was called and gave evidence to corroborate, generally speaking, as he said, the evidence of Mr. Rider. Cross-examined by Mr. Hutchinson, K.C. (for Beckenham, Chiswick, Finchley and Hornsey), he said that the loss of the tramway load made very little difference, although if they had this load it would modify the capital, making it slightly smaller.

Mr. COWARD said he had two other technical witnesses, Mr. Hammond and Mr. Snell, but as they would only confirm the evidence of Mr. Rider and Mr. Parshall, and not break any fresh ground, Mr. Freeman (for the promoters) said they would close their case now. Mr. Coward suggested that, to save time, the opposition should group themselves, say, the inside areas together, the outside together, and the companies together. Mr. Wedderburn approved of this suggestion.

At the resumption of the Committee on Wednesday, the Chairman said:—"The Committee find that the preamble of the Bill is not proved, and we shall report to the House accordingly."

The North Metropolitan Electric Power Bill.

Mr. JAMES DEVONSHIRE, director, having the management of the company's affairs, said the company was incorporated in 1900 to supply an area of 325 square miles. The Kitson Clause was incorporated in the Bill, and it was also provided that the operation of the company's powers in these districts should be suspended for three years so that the local authorities might have a chance. Nothing was done by the local authorities, and consequently the company now exercised their powers to supply energy not only to authorised distributors and users, but to traders requiring a supply for power purposes in the districts of Tottenham, Edmonton, Enfield, Wood Green, and Southgate. The object of the Bill was to give them the same powers in the rest of their district. They were supplying energy for 32 miles of tramway, and soon would be supplying to 50 miles, and this tramway supply gave them a good load factor. Witness proceeded to explain the meaning of a number of amendments made in the Bill at the instance of the Board of Trade, which brought the Bill into harmony with the County of Durham Bill of last year. One of the provisions provided by the Board of Trade was that the company might supply energy for lighting in an area where there was no authorised distributor. They were already giving a supply at ⅜d. per unit. In one case between 300 and 400 steam H.P. had been done away with and electrical energy taken from the company. The River Lea had a great attraction to manufacturers because of the water carriage, and if they could get cheap power they would take it. They were negotiating with one firm now who had applied to the L.C.C. to be allowed to build a new floor to their factory. The L.C.C. had refused, and the firm were negotiating for a site near their Brimsdown station. The company could not call itself an authorised distributor,

although he took it that in the special district he had referred to they had powers equivalent to those of an authorised distributor. They could not, however, at present supply to anyone outside the special area except those who were authorised by Parliament to receive it. There were certain parts of their district where no one had power to distribute energy at all—Harpenden for instance—and if this Bill passed they would be able to give a supply to that district without any more Parliamentary proceedings. The local authorities were, however, protected in case they wished to exercise their rights later. At present they could do nothing in the Harrow Co.'s area without their consent. They wanted to keep the Harrow district in the Bill in case they might get consent.

Sir DOUGLAS FOX was called, and stated that he was the engineer to the North-East London Railway. That company had power to erect a generating station, but it would probably be very much more to its advantage to take power from the company.

Prof. S. P. THOMPSON was called, and in answer to Mr. HUTCHINSON, said he thought that the petition of the Metropolitan Water Board was framed under a misapprehension, because there was nothing in the Bill giving new engineering powers. Electrolytic action could not possibly occur with the high-tension currents proposed to be employed, because they were alternating currents.

The CHAIRMAN said that with regard to the opposition of the Harrow Co., a clause had been handed in by the promoters, as follows:—"Notwithstanding anything contained in the section of this Act to which the marginal note is 'as to supply in special districts,' the company shall not supply energy under that section within the urban district of Harrow without the consent in writing of the Harrow Electric Light and Power Co."

Mr. CLEASE said that the Harrow Co. wanted to be excluded from the area.

Answering Mr. CLEASE, WITNESS said he thought the Harrow district ought to be included, because a large power company could supply more cheaply than a small one.

Cross-examined by Mr. MACASSEY, WITNESS said he was the engineer to the Clyde Valley Power Co. which promoted a scheme in 1901, and a clause similar to that which the Water Board now asked for was given to 40 local authorities. Since then there had been experience of high-tension alternating currents, and no case of electrolysis had occurred.

Mr. MURRAY, chief engineer to the company, replying to Mr. HUTCHINSON, said the capacity of the three generating stations of the company was 9,700 KW. They were about to erect a fourth station at St. Albans. The Brimsdown station was on the river Lea, and had a total capacity of 5,000 KW. Hertford station had a capacity of 300 KW., and supplied current in bulk to an authorised distributor. They intended shortly to transmit current from that station to Ware to an authorised distributor, and, possibly, to Hoddesdon. The Willesden station had a capacity of 4,400 KW., and an additional 1,500-KW. turbine was going in this autumn. The cost of the three stations was £244,528. They had 75 miles of mains. Brimsdown and Willesden stations were linked up by 21½ miles of main. The main carried 10,000-volts pressure, and from those mains they supplied nine sub-stations. They had entered into contracts, or were about to enter into them, for a large extension of these mains. The sub-stations contained 7,000 KW. of transforming plant. For the year ending December 31st they sold 7,999,367 units. They did not distribute any continuous current anywhere. They had had applications from manufacturers for a supply in Wembley and Wealdstone. They felt that no local authority could deal with the demand that was likely to arise. Witness proceeded to endorse the views of Prof. Thompson with regard to the impossibility of electrolytic action resulting from the use of the alternating current.

In cross-examination by Mr. CLEASE, WITNESS said that of their area of 325 square miles, they were supplying approximately half the district and three-quarters of the population. Of the 8,000,000 units supplied, 4½ millions were supplied to tramways within the area, and 2½ millions to Willesden. The prices charged to Willesden varied from ·75d. to 1·07d. per unit. The price for energy for tramways connected was a little under 1·4d. He considered that it was desirable that traders in Harrow should have the same opportunities as those in other districts.

Mr. CLEASE addressed the Committee for the Walthamstow Urban District Council.

The CHAIRMAN pointed out that under the Companies' Act of 1900, there was a proviso inserted giving special protection to Walthamstow. The clause which Mr. Clease handed in would give the company power to supply electricity for haulage, but it would exclude them from lighting the stations of the North-East London Railway.

Mr. SPENCER HAWES, electrical engineer, director of the Harrow Electric Light and Power Co., said the company had been at work in the district for 10 years. The capital was £78,000, and the company provided for all the electrical requirements of the district. They supplied for power purposes at 1½d. per unit. The North Metropolitan Power Co. had the power at present to supply them in bulk, and they were now considering whether they would take a supply. The North Metropolitan Co. now wished to increase their powers so as to be able to supply to persons requiring a supply for power. They also sought powers to supply for lighting, and there was no precedent for this. The Bill actually put the Power Co. into the position of being an authorised distributor under the Electric Lighting Acts. With regard to the clause which had been offered, it would be possible for the Power Co. to start an agitation amongst users and so enable them to come to Parliament for further powers.

Answering the CHAIRMAN, WITNESS produced an offer for the North Metropolitan Co. to supply his company in bulk on terms which worked out at about 1⅛d. per unit.

The CHAIRMAN said that as the Harrow Co. was charging 7d. and 4d. per unit for lighting, and in a few cases 1½d. per unit for power, it could not be said that the offer of the Power Co. was above that at which the Harrow Co. were supplying.

The Committee again adjourned.

On Thursday Mr. C. H. WORDINGHAM, electrical engineer, was called.

Mr. FITZGERALD: The suggestion put forward by the promoters is that electrolysis cannot be caused by alternating current?—Yes. I heard Professor Thompson, and I do not agree with the view that it is impossible for alternating currents to produce electrolysis.

Mr. FITZGERALD: In your opinion, as an electrician, is electrolytic action possible with alternating current?—Yes. I agree that the mains are very well protected, and that the precautions imposed by the Board of Trade are very good indeed, but I think that attention should be directed not only to the mains, but to the sub-stations with which the mains are connected. The system as a whole must be considered. If a leakage were to take place at several sub-stations the result would be that such leakage, as it took place, would be concentrated near to the generating station, and might do considerable damage to water-pipes.

Mr. FITZGERALD: The next point made by the promoters is that as regards fusion. They suggest that the construction of the mains and automatic safety devices prevent possible fusion?—I do not agree. Safety devices are one of the most unreliable things in electrical apparatus. You cannot be sure that they will always act. They are intentionally made to allow a certain interval of time to elapse, and a hole might be burned in cast-iron pipe in a quarter of a minute or less. In the case of high pressure mains, if a fault occurs it may be only a mere pin-hole through the insulation, and where there is a long main it is a very difficult matter to ascertain where this pin-hole is, and therefore it is very frequently a practice to burn out the main at that point with a view to making it easy to find.

And if a water pipe lay close to it would the great heat burn a hole in the pipe?—Yes.

So far as power companies were concerned, WITNESS said there was at present only a very small experience as to the efficiency of the Board of Trade regulations. Power companies had done much more in Parliament than anywhere else. The North Metropolitan Co. were at present supplying alternating current, but there was nothing to prevent them supplying continuous current. He certainly thought that a clause for the protection of the Water Board was necessary.

In cross-examination by Mr. BALFOUR BROWNE, WITNESS said he was formerly electrical engineer at Manchester, and he knew that the Lancashire Electric Power Co. got powers in the district and no protective clause was inserted for the Manchester Corporation water pipes. He knew that the B. of T. did not put in any electrolysis clause into light railway orders.

Have you got any case where either from a cable like this or from a connection with a sub-station electrolytic action has taken place?—No.

Mr. J. W. WRESTLER, deputy engineer to the Metropolitan Water Board, gave evidence as to a main running from Hampton through the south of London, alongside which was a telephone cable. Everything was all right with the telephone cable until the tramways in South London were electrified, and since then it had been greatly affected. Witness produced samples of the telephone cable, which had been damaged by electrolytic action.

In cross-examination, WITNESS admitted that the current used on the tramways was continuous, and it was not carried in a main such as that used by the North Metropolitan Co.

Mr. FITZGERALD addressed the Committee on behalf of the Water Board, and contended that, unless the clause asked for was inserted in the Bill, the company would be relieved from liability to make compensation which existed under the common law. In 1905, when the Administrative County of London Electric Power Bill was promoted, the promoters objected to the clause, but Lord Camperdown's Committee decided that it should be put in. The Metropolitan Electric Supply Co. submitted to a similar clause, and there had been five other cases in the last few sessions where metropolitan electric companies had submitted to the clause.

Mr. BALFOUR BROWNE said that leakage from mains could not take place with the cables of the company, and they had never heard of any leakage from sub-stations until Mr. Wordingham came into the box. Only in a case of negligence was a statutory company liable now, and he submitted that this was how the matter should remain.

After consideration in private, the CHAIRMAN announced that the preamble was proved, and they had decided to insert a clause for the protection of the Water Board. With regard to Walthamstow, they would strike out Clause 8, which had the effect of allowing the matter to stand as under the 1905 Act. As to Harrow, they would insert the clause offered by the promoters, which prohibited them from exercising any powers in the area of the Harrow Co. without their consent in writing.

Second Reading.—In the House of Commons on Monday the following Bills were read a second time: Aberdeen Corporation Electricity Bill; Oxford and District Tramways Bill.

Great Northern and City Railway Bill.—The Select Committee of the House of Lords before whom this Bill was to have come, has reported that all opposition has been withdrawn.

LEGAL.

ELECTROMOBILE CO., LTD. *v.* BRITISH ELECTROMOBILE CO., LTD.

THIS case came before Mr. Justice Warrington in the Chancery Division on Wednesday, June 19th. It was an action by the plaintiffs for an injunction to restrain the defendants from carrying on business in a name so like the plaintiffs as to be calculated to deceive.

Mr. C. A. RUSSELL, K.C., in opening the case said that in 1900 a company called the British and Foreign Vehicle Co. was formed, the principal promoter being Mr. Chambers, who was now the managing director of the plaintiff company. In January, 1902, it changed its name to the British Electromobile Co., Ltd. In October, 1902, the business was sold to the plaintiff company. At that time there was in existence the London Electromobile Syndicate. But the word electromobile was written in two words, and as that company did business in a cheaper kind of car than the plaintiffs, it did not matter much to the plaintiffs, and, moreover, that company had now practically ceased to exist. The defendant company was formed on April 8th last, and they proceeded to do business in cars suitable for the town and in the west-end of London where the plaintiff's carried on business. The learned counsel contended that the similarity of name was calculated to do the plaintiffs a great deal of harm.

Lord MONTAGU, afterwards examined by Mr. RUSSELL, K.C., said he was one of the vice-presidents of the Royal Automobile Club, editor of the *Car Illustrated*, and chairman of the Parliamentary Automobile Committee. He was well acquainted and closely connected with the motor-car industry. Except the plaintiff company, he knew of no other firm manufacturing electric cars which described its cars as electromobiles.

Cross-examined by Mr. ATKINS, K.C., WITNESS said the plaintiff company came into existence in 1902. He had not heard of the word electromobile being used before 1902, but it might have been used in America. Electromobile was descriptive of an electric car. Up till 1902 the word electromobile was used in the generic sense, but since then it had acquired a special meaning and was applied to one particular kind of car.

Mr. T. G. CHAMBERS, the managing director of the plaintiff company, also gave evidence generally corroborating the evidence of the last witness.

In the result Mr. Justice WARRINGTON said that the word electromobile, like other equally barbarous words, had a limited meaning. It was not part of the English language, but it was part of the language used in this country to describe a vehicle driven by electricity. He considered that the plaintiffs had not made out their case, and in these circumstances there would be judgment for the defendants, with costs.

ELECTRICITY IN MINES: TEST ACTION AT FIFE.

A FATAL accident caused through an electric coal-cutting machine led to a test case being raised by the Home Office. The complaint was against Thomas Borland, jun., Kincardine-on-Forth, certificated colliery manager, of the Kincardine Coal Co., Ltd., owners of Hawkhill Colliery, and set forth that he, having about the month of October, 1906, installed and used, or permitted to be installed or used, in No. 1 pit of said colliery, an "Anderson-Boyes" continuous-current electrical coal-cutter, with relative trailing cable and conductors, by which a fatal accident was caused on December 24th to David Hunter, miner,

1. Did, during the period between October, 1906, and May, 1907, neglect to have a competent person on duty at said mine when said machinery and apparatus was in use, and to have all the persons appointed to work the same instructed in their duty and competent for the work that they were set to do;

2. Neglected to have the trailing cable heavily insulated, in respect that the insulating material was only ·041 of an inch thick, whereas it should have been not less than ·062 thick, and also neglected to have said trailing cable for about 18 in. from the cutter protected with leather lacing or other effective covering; and

3. Neglected to have substantially bushed by insulating bushes four holes in the middle motor casing of the cutter, through which holes there passed an unarmoured electrical cable or wires, which, instead of being covered with insulating material, were covered with cotton only, and drawn into india-rubber tubing.

A plea of not guilty was tendered.

The man who was working at the coal-cutter when the accident occurred explained the steps which he took when it became known that the machine and the wire rope had become "alive." He left the machine to find a dry prop with which to knock off the switch handle of the machine. Another workman stated that nothing had gone wrong with the machinery until the accident in question. John Menzies, electrician, Wishaw, said the accident was due to the wiring and the cable becoming exposed and coming into contact with the metal. The coal-cutter and wire rope then became charged. In his opinion a strain had been put upon the cable and caused the covering to tear. In cross-examination, he admitted that it was quite possible that the accident could be traced to carelessness on the part of the workmen. Alex. Anderson, electrical engineer, Motherwell, one of the firm supplying the coal-cutters, said they had endeavoured to bring the machines and electric cables as much within the rules as was possible.

The INSPECTOR OF MINES, in the course of his evidence, held that if the bush had been insulated as ordered by the rules, the accident would not have happened. It would have required a man with electrical knowledge to have discovered that the insulation was worn through.

GILBERT SCOTT RAM, electrical expert in the Home Office Factory Department, stated that in his opinion the four holes in the motor casing were not bushed according to the rule. He stated further that the insulating of the trailing cable at the colliery was thinner than that of ordinary cable. Cross-examined he said it was lucky there had only been the one accident by the method of bushing complained of. If the machines were kept on running under the same conditions, he would not be surprised if there were more accidents.

Examined for the defence, JAMES BOYD SHIELD, electrical and mechanical engineer, said that his firm, Anderson, Boyes, & Co., had placed 117 coal-cutting machines similar to the one at Hawkhill on the market, and until that prosecution he never heard a suggestion as to there being anything deficient in their construction. In practice the trailing cable insulation had been found sufficient and safe.

ARCHIBALD JOHN HEDGECOCK, chief engineer, Henley's Telegraph Works Co., London, by whom the cables were made, said the cable as supplied to the Kincardine Coal Company was good for 620 volts, while it was only run at 450. The rubber tubing answered the purpose of a bush, and was a bush, in fact. Archibald Smillie, colliery manager, New Cumnock; James Douglas Allan, Clyde Valley Power Company; Daniel Burns, mining engineer and lecturer, Glasgow Technical College; Nigel Cohen, electrical engineer, Dunfermline; and Robert Rae, electrical machineman, Motherwell, were all examined, and agreed that the rules had been observed at Hawkhill. Three employees spoke to the instruction and the competence of the men engaged on the machine.

The SHERIFF intimated that he would give his decision on the 28th inst.

HISCOCK *v.* IRWIN.

AT the Wandsworth County Court on Monday, before his Honour Judge Russell, the case of Hiscock *v.* Irwin came on for hearing, it being an action brought by an electrical engineer to recover from the defendant, who was described as of 303, Essex Road, Islington, the sum of £70 odd, balance of an account for installing the electric light in some flats over business premises at Neal's Corner Hounslow.

Mr. Roskill, K.C., and Mr. Morle were counsel for the plaintiff, and Mr. Edward Morton, barrister, was for the defendant.

In the course of his opening, Mr. ROSKILL said this was the re-trial of an action brought in that Court in January last against Mr. Edward Neal, of Geneva Cottages, Kew Gardens, and the present defendant, Mr. William Irwin. His Honour then gave judgment against Neal, and ordered the plaintiff to pay Irwin's costs, Neal to repay them back to plaintiff. Neal appealed to the Divisional Court, and the appeal was allowed, Justices Phillimore and Bray ordering the re-trial of the case as between plaintiff and Irwin, reserving to his Honour's discretion the question of the plaintiff's costs of the first trial, and of the appeal, and of Neal's costs as against Irwin. The Divisional Court left the case in a very unsatisfactory condition, but he (Mr. Roskill) contended that Irwin was liable. He did not know whether his Honour had any recollection of the original action, but it was brought by a sub-contractor for electric lighting work, Irwin being the contractor and Neal the building owner. In the contract between Neal and Irwin provision was made for £150 for electric light and bells, the specification being got out by Mr. Davis, the builder's architect. Irwin himself tendered in June, 1904, the specification being for electric light fittings, lamps, and so forth. The sum of £150 was to be the prime cost of electric lighting and bells.

Mr. MORTON said that only "bells" was mentioned in the original.

Mr. ROSKILL said that the item for bells, viz., £17, was so small that it was obvious that prime cost, £150, could not have referred to bells alone.

Mr. MORTON said he was not contending that it was, but the specification said "£150 prime cost of wiring electric light."

Mr. ROSKILL went on to say that Irwin tendered, but his tender was refused. Hiscock also tendered and did the work, and there was no suggestion that the work was not well done. Irwin and Neal were now at litigation, and the other day they were before Mr. Justice Joyce. His (the learned counsel's) submission now was that the plaintiff was entitled to every penny Mr. Davis had certified, and that Irwin had no power to dispute it.

His HONOUR said it was an extraordinary state of affairs.

Mr. ROSKILL said it was a very unsatisfactory state of affairs for the man who had done the work, and had not been paid. But for the pending litigation between Neal and Irwin, his Honour would never have been troubled with the case. Irwin was suing Neal for £555, and Neal was counterclaiming £1,445, and included in Irwin's claim against Neal was the whole £150 for the work now under discussion. Apparently it was disputed that Davis had authority to issue the specification for this wiring and fitting. In September, 1904, Davis wrote to Irwin asking him to pay Hiscock £75 on account of the work of "electric lighting and bells," but the point was now being taken that in the old estimate only "bells" was mentioned. On September 16th, however, Irwin sent Hiscock a cheque for £75 "on account of electric lighting work," and in his receipt Hiscock mentioned "electric lighting and bell work." Irwin subsequently wrote, saying he had given no order for the work, and referring Hiscock to Neal, and it was at the suggestion of Irwin's solicitor that Hiscock sued Neal, and if he failed he was to sue Irwin. There was a mass of authority for saying that if an architect certified that a person was entitled to payment unless there was fraud the person was entitled to payment.

Mr. Morton contended that there was no authority on the point.

Mr. Roskill said Neal would swear that he had paid Irwin the full amount of this specification, therefore Irwin was bound to pay Hiscock. He should ask his Honour to find that Davis was the only person who could dispute the payment, and that the plaintiff was entitled to judgment.

Alfred Hiscock, manager to the plaintiff Thomas Hiscock, electrical engineer, of High Street, Hounslow, formally proved that their tender was accepted, and that the work was completed in 1905, when an account was rendered to Irwin, who had paid £75 on account.

By Mr. Morton: The total of his account for wiring and bells was £151 1s. 9d. There were four three-light electroliers at 30s. each, and 56 one-light brackets at about 13s. each.

Mr. William Davis, M.I.C.E., and architect, spoke to the acceptance of Hiscock's tender, which was gone through by Neal, as was Irwin's.

Mr. Roskill: What is the meaning of electric wiring?

Mr. Morton objected, and

His Honour upheld the objection.

In cross-examination, Witness said that at Hounslow the wiring did not belong to the landlord and the fittings to the tenant; they all went together. It was true that witness had become the tenant of one of the flats in question.

His Honour observed that this was commented on by Mr. Justice Phillimore.

Edward Neal, in giving evidence, said he had paid Irwin £6,000 and was claiming the return of £1,400. Irwin had received the amount due to Hiscock for this work.

Mr. Percy Rycroft, electrical engineer to the Hounslow and Heston District Council, stated that "electric wiring" was a short terms for an electric installation, including fittings and bells. Witness had examined the fittings supplied by the plaintiff, and allowing a fair margin of profit he thought they were worth £29 8s. 11d.

By Mr. Morton: Hiscock was a contractor, and witness was not.

This closed the plaintiffs case, and

Mr. Morton said he did not propose to call any evidence.

Mr. Roskill submitted that it was an undefended action.

Mr. Morton said the point he wanted to take to the Court of Appeal was that there was no case reported which fixed a contractor with liability where an order was given by an architect and not by the builder himself. He suggested that Neal was liable.

His Honour said that could not be entertained for one moment, in view of what had occurred in the Divisional Court.

In giving judgment, His Honour said the logical result of the decision of the Divisional Court was that Irwin must be liable. There was ample evidence of Davis's authority, and he found for the plaintiff for the full amount claimed. He refused to allow the plaintiff the costs of the appeal, but he gave him the costs of the action, and of that day's trial.

Disputed Loan.

At the Edmonton County Court on Wednesday last week, Rodney H. Molesworth, of Brackenstone, Pembury, Kent, sued Stephen Horwath, an electrical engineer, of Woodside Gardens, Bruce Grove, Tottenham, for £80 money lent. Each party was represented by counsel. Plaintiff and defendant were formerly associated as directors of a company for the manufacture of electric incandescent lamps, which has been re-constituted under the style of the Britannia Electric Lamp Works, Ltd. The plaintiff advanced the £80 in September, 1905, at a time when the defendant was being pressed under a bill of sale. The defendant admitted that he had the money, but he contended that the plaintiff released him from the debt in connection with a share transaction wherein additional money was brought into the company. The plaintiff, who said that he put £500 into the company when he joined it, and who has now left it, denied this.

Judgment was given for the plaintiff for the amount claimed.

Taylor *v.* Dublin United Tramways Co., Ltd.

This case was heard at Dublin last week. Plaintiff claimed £2,000 damages for personal injuries caused by the alleged negligence of the servants of the defendants by reason of a trolley pole striking him while he was a passenger on one of the company's cars. He further claimed £2,000 as special damages owing to the circumstance that since the accident he had lost his position as clerk in the employment of Messrs. J. H. North & Co., and was unable to do any work. The defendants denied the alleged negligence, and submitted that the damages sued for were not the reasonable or probable result of the acts complained of. The accident occurred on the morning of October 17th.

The jury found for the plaintiff, and assessed damages at £550.

Stopping Electric Cars.

Mr. Broughton, a Carlisle solicitor, on Monday, raised a point of considerable interest to tramcar passengers, in a summons directed against the Carlisle Electric Tramways Co. The question was: must a tramcar conductor stop his car whenever requested? Mr. Broughton contended that legally he must, and his summons was against the driver who had refused to do so. On the other hand, the company held that they were only obliged to stop at the posts indicating stopping places. The magistrates upheld Mr. Broughton's view, and ordered the defendants to pay the costs. Mr. Broughton said he would continue to summon them if they refused to stop.

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Electrical Trade.

I notice that your correspondent, "Agnostic," in his article on the above, makes the primary deduction that the remedy for the existing stagnation is to "support the contractor." He states:—

"If the manufacturers and central station engineers will recognise the value and status of the contractor, and loyally support him, it will eventually tend to the ultimate advantages of both and aid in the reconstruction of the retailing branch of the business on a sound basis."

What efforts do the contractors make to support themselves?

Probably by this time "Agnostic" will have read the report of the Contractors' Association showing what a healthy (?) state that body is in and how it is working for its own salvation, and—on his showing—therefore for the salvation of the electrical industry.

I hold no brief for the manufacturers, who have—as he states—surreptitiously or otherwise usurped the position which should legitimately be held by the contractors, but surely "Agnostic" would not, as his article leads one to suppose, vote that the manufacturers should stand aloof and allow their interests to be solely in the hands of such a body as the contractors. For what has happened, is happening, and likely to happen so far as the contractors are concerned? Instead of making a dead set against the encroachment of cheap foreign manufacturers, they have fallen into the trap and pandered to them to an extent which has become disastrous to the whole of the electrical community. If their idea was to popularise electricity as a commercial commodity, and at the same time obtain the best pecuniary results for themselves, surely the game has been overdone.

Then why cast all the blame on manufacturers and consulting engineers, who, by the action of the contractors, have been forced (I venture to make a general statement) very much against their will to follow the lead?

Fortunately there still remain some manufacturing firms who have throughout fought against this disastrous policy and maintained, through good report and ill, a standard of excellence at fair and profit making-prices. (These are the firms who are able to weather the present rough times, and when the great revival comes about will, undoubtedly, reap the reward of their efforts by a good participation in the improved trade).

These are the firms, who, if the contractors would only have seen it, and would only see it, have tried to support him through thick and thin, for what more support could they give him than supplying the best materials which, by their installation in a workmanlike manner, reflect credit on every branch of the trade. And again, it must not be overlooked that the cheapness of an installation does not lie in prime cost, but in the quality of the material and workmanship supplied to ensure subsequent satisfactory working to the client, and thus secure his valuable recommendation—the best advertisement a contractor could desire.

What consumer of electricity would grumble, or rather, would have grumbled, if he could have this point thoroughly instilled into him? For, presumably, where electrical installations can be afforded, a few pounds more or less at first cost would not make material difference.

Have the contractors made systematic and organised efforts to bring this about? No! By their failure to trust each other, and to eliminate from their ranks the unqualified and ignorant individuals who have crept in, in the mad scramble to get a job at any price (and get out of it anyhow), they have so imbued the consumer with the idea that primary cheapness is the essence of the contract, that even reputable contracting firms, of whom I am pleased to agree with "Agnostic" some are still left, find themselves compelled to fall into line with the general run.

Why revile the consulting engineers? Allowing for all

their "fads" and divergence of views, I venture to say that a very small percentage of contracting firms would be capable of carrying out an installation of any size without the guidance or under the direction of these gentlemen; and if these have to some extent become imbued with the cheap-price creed, it must be admitted they were not the prime instigators; the contractors, as I assert again, by their persistence in putting in such ridiculous prices for competitive tenders, having forced the position, else how do we account for variations of 100 per cent. in the figures of firms tendering to the same specification?

One point in favour of the consulting engineers is frequently lost sight of. Although they accept in a good many instances the lowest price, this is very often compulsory to them—notwithstanding their advice to their clients as to the better value which could be given at slightly increased cost—the demon of "cheap price" having been fostered to such an extent that very often the client knows almost to a penny what he can get an installation for, based on the present standard of prices, and not recognising that the after-part is far more important to his convenience and pocket than consideration of prime cost.

Another point for the consulting engineers is that, by virtue of their social position, they have opportunities of promoting, by persuasiveness or otherwise, trade amongst society to which the contractor would be denied the right of of entry—*i.e.*, as regards taking the initiative.

Then why revile the consulting engineer? No! The contractor should make more effort to support himself by his earnest endeavours to get the consumer to appreciate the difference between good and inferior material, and I am sure no one more than consulting engineers and manufacturers would be more willing to loyally back him up.

It is "never too late to mend"; and if the electrical industry in this country is to experience an approach towards the more prosperous days of the past, it is necessary that contractors should do something towards supporting themselves, and not look upon the present agitation as so much clap-trap, permitting themselves still to remain in a state of calm indifference towards the vital cause of the position.

Hopeful.

I have been much interested in the correspondence appearing under the heading of "Electrical Trade." Your correspondent who signs himself "A Livelihood and a Little Over," hits the nail hard on the head when pointing out the weakness of contractors whose profit on a wiring job really consists of what they can make on "the fittings."

This is becoming quite a common occurrence; and in two instances that recently came before my notice the contractors' clients purchased their fittings through another source, and had them fixed by a third firm.

The contractors in these two instances apparently lost on their wiring.

We are all accustomed to jerry wiring in "all its branches," and it is pleasing to see some of our station engineers waking up to the fact that there are "Jerry ones" in their midst, and the only sensible way to weed out these undesirables is to enforce stringent wiring rules and tests and not to leave the last item to juniors, who are too often interested parties.

Your correspondent, who, by his title, apparently ekes out a bare existence, mentions the contractor in the old days as the sole source of supply "from a binding screw to an 'A' Gramme dynamo." There is no doubt that his statement is true and the contractors have themselves to thank for the change—their motto has been of late years, buy the cheapest and sell the dearest—that is to say, it does not matter a straw that the Gramme dynamo is the best unless, according to the contractor, it is the cheapest, or, in other words, leaves the largest margin of profit.

The fear of further trespassing on your space prevents my giving some interesting instances of "cutting prices" and the results, but in closing I would point out that the poor consumers who really suffer at the hands of such contractors deserve not only our sympathy but also the protection of the station engineer, or some qualified person who is above suspicion, and who insists on the binding screw and dynamo referred to being the best of their kind,

Satisfaction.

I thoroughly agree with the article by "Agnostic" regarding the state of the electrical trade, and there is no doubt that it is at present in a most disorganised (or as "An Interested Spectator" prefers to put it, "drunken") state.

Take almost any other trade one can think of and there is some sort of organisation; other trades generally being divided by distinct demarcation into manufacturers, wholesale houses and retail houses, and it is practically impossible for anyone outside that particular trade to buy from the wholesale houses, much less from the manufacturers. This is legitimate and organised trading, but it does not hold in the electrical trade. In my opinion until some such system as this is rigidly adopted in the electrical trade it will continue in its present demoralised state. At present if a man thinks in bed one night that an electric motor would save him money on certain of his work, when he goes to business the next morning he finds representatives of manufacturing firms, agents, contractors and wholesale houses, as well as from the supply company, waiting for him, each one trying to cut the other out. The buyer begins to think himself a little king and he thinks that if he waits long enough and lets these people cut at one another long enough, he will get the motor for nothing. If he is wise he can undoubtedly get the motor for next to nothing. I will admit that I cannot see a means of bringing about any better organisation of the trade, but it appears to me that the only body which could take the matter up is our Institution.

In connection with this subject some of your readers have been decrying the consulting engineers, but in my opinion a consulting engineer is in many cases necessary between buyer and contractor; and if the consulting engineer knows his business, is honest, and is able to divide up the contract into suitable sections, so that each section can be bought in the cheapest market, the consultant can more than save the buyer the fees paid to the consulting engineer. Where, however, the consulting engineer simply hands over the whole job and responsibility to one firm, then he is shirking his responsibility and the buyer could have done just as well himself and saved the consultant's fees. I know many keen buyers who know what they want, will have nothing else, and are not afraid to buy in the cheapest market. These men in many cases more than save their fees or salary in buying alone, and it is a pleasure to deal with them.

I trust for the sake of the profession that something will be done to improve the present "drunken" state of the trade, and feel sure that your discussion is of great interest to the whole of the trade.

Richard C. Dieppe, A.M.I.E.E.

London, S.E., *June 22nd*, 1907.

I have read with much interest the recent correspondence appearing in your valued paper upon the above subject.

Many interesting points of view are therein revealed, but most of them, I think, can but be considered as secondary in an attempted explanation of the present state of the electrical trade in this country.

It may be a fact that there is not sufficient home business to fill and keep constantly going all the large factories now established; but looking at the figures constituting the turnovers of some of our leading companies (including, of course, a certain amount for foreign business), it is, I think, evident that, with prices on a fair basis, a considerable dividend-paying profit would be made, instead of, as at present, either a loss or not even sufficient to cover depreciation.

Over-capitalisation, with the consequent need of large turnovers and considerable profits wherewith to satisfy shareholders, has resulted in an insane cutting of prices down to, and below, costs, and herein I think is to be found the chief cause of the present difficulty, which can be summed up in a few words, *i.e.*, inability to make money.

Why cannot, as has many times before been suggested, the heads of our large manufacturing companies consult together and endeavour to devise some workable arrangement whereby a fair margin of profit would be added to costs? There should be no difficulty in doing this, and, under such a scheme, the chief factors in the fight for securing business would, in the majority of cases at least, be reduced to practically two, *i.e.*, (1) low works' costs, and (2) merit—fair conditions under which anyone could work.

While the influence of the consulting engineer has undoubtedly had a great deal to do with hindering standardisation, yet, under some such arrangement as above mentioned, all their whims (and they are many) would not prevent a fair return being secured to the manufacturer, which, after all, is the chief consideration.

The neglect of contractors (and I assume by this term is included the large body of retailers), has been advanced as a factor in preventing a greater development of the industry. This may be true to a certain extent in the case of small supply articles, but is, I think, hardly applicable to the larger lines of apparatus which form the bulk of the business, and which are not handled by retailers.

It can hardly be disputed that we should, in a measure at least, gain by imposing a protective tariff on foreign manufactured articles, as, in addition to keeping out a large quantity of cheap foreign goods, we should at the same time have a strong argument with which to bargain for better terms in entering markets which are now absolutely closed to us, due to the exercise of this principle by other countries.

It is, indeed, high time that those who have such large vested interests in their hands should stir themselves, and endeavour to place this, the youngest and one of the most promising of our industries, on a proper paying basis, and thus render to the shareholders (in whose employ they are) some return for investments.

As long as the present insane policy of manufacturing goods to give away is followed, no great improvement can be looked for.

Sane Competition.

June 24th, 1907.

The Literary Engineer.

With a certain portion of the editorial remarks upon my letter which appears in this week's issue of the ELECTRICAL REVIEW, I quite agree. The unread man is almost necessarily of narrow mind, but it by no means follows that he has not therefore anything to say, nor that, though he may not be able to say it in even reasonably good English, he should not be allowed to say it. In engineering work, the unread man is the practical man, and I think all of us are only too anxious to know what the practical man's views are upon every question that arises. The practical man's views of what is possible, and of the methods of dealing with difficulties that will arise, will often be incorrect, but his experience, within his own limited range, must be correct.

On the other hand, I claim that you are in practical agreement with me. What I am pleading for is reasonably good English; what I am objecting to is pedantically pure English. I think it will be the common experience that pedantically pure English is very often almost unreadable. It is like reading a foreign language. Take Herbert Spencer and Browning, for instance. Admittedly they are masters of English, and they have very numerous worshippers, yet everyone knows that most of us leave them severely alone, merely because we have not time to think out what they mean. Huxley and Tyndall, on the other hand, whom I believe I am correct in saying did not always write purely grammatical English, are noted for the manner in which they are able to convey their meaning to their readers, and for the enormous good they have done thereby, in the advance of Science.

But the columns of your own issue of June 14th contain a case, strikingly illustrative of the point I wish to make, in the letter of Mr. Elliott, criticising the article of Mr. "Ben Frank," and your editorial remarks thereon. It is just that pedantry, the objection to the use of the term sliding rail, in describing a well-known apparatus, in place of slide rail, and similar cases, that I am protesting against. In your editorial remarks you gave several instances of words, such as eating-house, that are not grammatically correct, but are commonly used. I would suggest another which bears more directly upon the subject, viz., skating-rink. I imagine that even the most pedantic purist would not imagine that when one talks of skating-rink, one means a rink that skates.

I take the ground that the use of language is to convey meaning to readers or hearers, and that the language which most readily and quickly conveys that meaning, is the best language to be employed, and I further take the ground, that pedantically pure grammar very often does not fulfil those requirements.

In my view, the engineer who writes should strive to attain the same object, in his line, as the novelist does in his. The novelist whose characters live, is the one, to my mind, who best fulfils his proper function. In "Painted Rock," for instance, the characters *live*. One can *see* the two candidates for the office of City Marshal of Painted Rock manœuvring to arrest each other. One can *see* the two bullies facing each other in the saloon in "Painted Rock." Similarly one can see the parts of the human body described by Huxley, and the experiments described by Tyndal, and, to my mind, that is the object to be attained.

Sydney F. Walker.

Bath, *June 24th*, 1907.

Electrically-Driven Cement Works.

My attention has just been drawn to the letter signed "Alfred S. L. Barnes" which appeared in your issue of May 31st. The question raised by Mr. Barnes is of no great importance, but is yet of some interest: Which was the first cement works in the kingdom to be electrically-driven throughout?

Your readers will remember that this honour was claimed (in an article which you published recently) on behalf of Messrs. Casebourne, of West Hartlepool. Mr. Barnes, writing from Gibraltar, referred you to an installation which he erected in Kent about seven years ago. It is a pity that he did not give the name of the firm referred to, since this is not a manufacturers' quarrel as to the quality of goods, but a mere question of fact.

Should I be wrong in supposing that this firm is the Wouldham Cement Co., near Rochester? If so, I would ask Mr. Barnes (in view of his statement that "everything was electrically-driven throughout, even to a lift and an electric locomotive"): Was the washing, slurry-grinding, and clinker-grinding plant so driven?

Also, in your issue of last Friday was published a letter from Mr. Frank P. Spicer, in which attention is drawn to the fact that, in 1900, Messrs. Mather & Platt supplied complete electrical equipment for a cement works at Swanscombe.

I am cognizant that here again the Rotary-kiln plant is driven electrically, but am uncertain whether this method extends to the plant for washing and grinding. Perhaps the above-mentioned gentlemen will kindly reply.

Otherwise honours must remain with Messrs. Casebourne.

H. T.

June 24th, 1907.

Wiring Cost of Small Houses.

I am sorry to see the letter from Mr. Jackson in your current issue, because I think it will be acknowledged from the following remarks that in addition to the absence of stringent regulations and hampering conditions, local contractors are treated exceptionally well.

As against Mr. Jackson's statement that contractors have lost orders through this department, I have to say that during the past few months over 100 jobs, *canvassed for and obtained by this department*, and at its own expense, have been given out to contractors, and only in one case has a job been given to a firm outside the borough. The majority of these jobs being on the hire-purchase system, I can say that practically none of them would have been carried out at all had not the Corporation's hire and hire-purchase system for wiring, motors, and apparatus been in existence. Mr. Jackson's statement, therefore, is an absolute misrepresentation of the facts.

A contractor canvassing and obtaining a consumer upon the hire-purchase wiring system gets the job without competition if his price is within reason.

The Corporation have powers to do wiring, make and sell apparatus, &c., and members of my Committee have pressed me to commence a wiring department; but, with the exception of small jobs under about £5, where the expense of

going over the job with two or three contractors for prices is out of all proportion to its value, we have not commenced a wiring department purely out of consideration for the contractors; even in cases of motors on hire, the wiring is sub-let by us.

You can take it from me that we do not make it a practice of giving metallic filament lamps away. I have not, and would not under any consideration whatever, promise not to sell metallic filament lamps, they are of such vital importance to us that we shall endeavour by every means in our power to control their use in our district. We do not make a practice of selling carbon lamps, we sell and maintain arc lamps and metal filament lamps, fittings, fans, heating apparatus, but at the full trade prices, as the sale of electricity cannot be carried on without them.

As regards cutting, I know of no case where we have taken the work out of a contractor's hands, unless he was making a mess of it, or for some other equally good reason, but where we are directly up against suction gas for power, or the gas company for lighting, we allow nothing and no one to stand in the way of electricity going in.

I repeat I am sorry Mr. Jackson thought fit to write as he did, because we have done, and are doing, our best to assist and co-operate with local contractors.

A. Hugh Seabrook,
Engineer and Manager.

Stratford, *June 24th*, 1907.

Making Calcium Carbide in Ireland.

There are many isolated water-powers of about 100 H.P., but not much more, at present utilised for supplying electric light to country towns from dusk to midnight. With a view to increasing the earning capacity of such a water-power, it is desirable to procure a load that would utilise it during the daytime, and consisting of a manufacturing process carried out on the premises.

Perhaps Mr. W. Antrobus would kindly supply particulars of the above to one who cannot just now avail himself of his kind invitation.

Querist.

"BOOSTER" wishes to hear of any installation of sewage sterilisation by means of electricity at present in use.

INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION.

TWELFTH ANNUAL CONVENTION.

THE opening meeting of the Convention on Tuesday took place at the Town Hall, Sheffield. The members and visitors were welcomed by the Lord Mayor, Alderman R. Styring, who referred to the good work carried out by the Association and by its President in connection with the Sheffield Electricity Supply Department. He remarked that electricity was destined to play an important *rôle* in connection with local industries, particularly steel making; it was, however, locally subject to very severe competition from gas.

Mr. Fedden, after having thanked his Lordship on behalf of the Association, read his presidential address, Alderman Pearson (Bristol) returning thanks. We refer at some length to the more interesting portions of Mr. Fedden's address in our leading pages.

Mr. Acland then read his paper on "Extension of Electricity Supply to Outlying Districts," of which we give an abstract below. The afternoon was given up to a tour of Messrs. Vickers, Maxim's River Don Works, where the visitors, among other things, witnessed the rolling of armour plates, wheel tires, &c., and inspected the extensive gun-making department. As is well known, electricity plays a prominent part in the operations of the firm.

In the evening a largely-attended reception and dance was held at the Town Hall by the Lord Mayor. The whole of Wednesday was devoted to an excursion to the Dukeries.

Extension of Electricity Supply to Outlying Districts.

The first paper was read by Mr. R. L. Acland, borough electrical engineer, Chesterfield, and dealt with the method adopted for economically supplying a small area 1½ miles beyond the edge of the mains network, and 2½ miles from the power house. We may note that a description of the electricity and tramways undertakings of Chesterfield, appeared in our issue of February 9th, 1906, p. 219, and that an account of the system explained in the paper was published in our issue of September 28th, 1906, p. 502. Various systems of transmission were considered, and eventually it was decided to utilise the tramway feeders, which extended to the district in question and were of ample section. The costs of the different methods were estimated to be as follows:—

High pressure transmission with D.C. supply ...	£1,770
" " " A.C. supply ...	£1,560
Low pressure transmission from lighting supply	£3,500
" " " traction supply (with accumulators)	£1,720
Low pressure transmission from traction supply direct with voltage regulator	£600

The cost of the local network is not included in these figures.

Connection is made with the trolley-wire feeder and the rails in a feeder pillar, whence mains are taken to a sub-station containing a 75-H.P. motor coupled to a 50-KW. compound-wound generator. The set is started in the early morning by a man who attends to the bearings and brushes, recording instruments, &c.; it is shut down at midnight by opening the feeder switch in the power station. The labour cost thus amounts to only 6s. per week.

On account of the wide variation in voltage on the tramway feeder, it was necessary to provide automatic regulation in the sub-station; for this purpose a Tirrill regulator is connected with the generator, and acts on the shunt rheostat, rapidly inserting and cutting-out resistance in the shunt field circuit, under the control of a solenoid and spring, with the result that a remarkably uniform voltage is maintained on the bus-bars, provided that the silver contacts of the regulator are kept in good order.

DISCUSSION.

The discussion was opened by Mr. GEO. WILKINSON (Harrogate), who remarked that the great tramway extension of recent times would appear to facilitate such work as Mr. Acland had described, if only pressure regulation could be assured. He noted that Harrogate saw the first Tirrill regulator introduced into public service—it was adopted because it enabled a cheaper generator to be used. He thought the author ought to apportion the cost of his sub-station feeder between tramways and lighting, in order to obtain a correct comparison. His experience was that platinum contacts were very necessary with the Tirrill regulator.

Mr. S. L. PEARCE (Manchester) doubted the practical economy of the arrangement used by the author; it appeared, from the circuit-breaker in use, that some stoppage of supply must certainly occur.

Another speaker doubted the wisdom of putting down the system, unless as a temporary measure. If the capital were even doubled, it was a small item, and the A.C. transmission seemed a better way of dealing with the matter.

Mr. F. AYTON (Ipswich) doubted whether the system was applicable as a rule under tramway conditions, especially as tramway feeders were designed for average rather than maximum loads.

Other speakers included Mr. ALEX. CRAMB (Croydon), who used the Tirrill regulator under abnormal conditions with very satisfactory results; Mr. C. TURNBULL (Tynemouth) who advocated the use of separate exciters on large units, the exciter fields being regulated by the Tirrill device; Mr. V. A. H. MCCOWEN (Salford) who pointed out that 800-KW. units were controlled by Tirrill apparatus at Salford, and that but little trouble was experienced with the contacts; and Mr. LONG (Norwich), who came to the conclusion that when all costs were included and capitalised, A.C. transmission would probably be as cheap as any other.

Mr. ACLAND, in replying, said he found that silver contacts (as used at Chesterfield) did not wear as long as platinum, but gave equally satisfactory results. As regards reliability of supply, he mentioned that the generator circuit-breaker was fitted with a time-limit relay, which got over brief fluctuations. The feeder pillar was also fitted with circuit-breakers connected with a bell on a tramway standard; the bell would warn passing motormen to replace the breakers. Nothing amiss had occurred during the 10 months' run, and only shop lighting was called for.

In some closing remarks, Mr. FEDDEN said that he had a Tirrill regulator at each station, and they were absolutely necessary, as hand regulation was quite inadequate; but it was necessary to have a man to look after the regulator in each case, and he could not understand how the Chesterfield regulator worked for 18 hours a day without attendance.

(To be continued.)

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

B.T.-H. Flame Arc Lamps.

FIG. 1.—B.T.-H. FLAME ARC LAMP.

B.T.-H. flame arc lamps are made for either continuous or alternating-current circuits, and are weather-proof, dust-proof, and suitable for outside or inside use. They do not give off objectionable fumes, and the deposits from the carbons are not allowed to reach the working parts. The differential method of control, with shunt and series magnets, is used. The shunt magnets are wound with wire having a patent enamel insulation, which does not deteriorate with heat or moisture. The carbons are arranged at an acute angle and are fed by gravity. The feeding mechanism is simple in construction, and gives close and uniform regulation of the arc. The mechanical design is strong and simple, without clockwork, spiral springs or stampings. Mechanical and electrical adjustments are easily understood and made. Standard D.C. lamps are made for a current of 8 amperes, and A.C. lamps for 10 amperes, 50 periods, but lamps for other currents and periodicities are supplied to order.

Both A.C. and D.C. lamps are made in two sizes, one taking 24-in. carbons and burning 17 hours, and the other taking 16-in. carbons and burning 10 hours. One line resistance is required for each series of lamps; it is made of special high resistance non-expansive wire, wound on porcelain cylinders, mounted on cast-iron bases, and with perforated iron covers.

One substitutional resistance and cut-out is needed for each D.C. lamp when the line voltage exceeds 230. In case of failure of a lamp from any cause, an equivalent resistance is automatically switched in, and the remaining lamps burn without interruption. The standard form is weather-proof, and arranged for hanging directly above the lamp, but they can be supplied on brackets for mounting in a pole base or on a wall. The compensators are transformers with single windings, and are required for A.C. lamps when the voltage is above 120. The primary is connected across the line, and two lamps are connected in series across the secondary. Special compensators can be supplied for any usual line voltage or number of lamps.

The globes are of light opalescent glass, 10 in. in diameter, and fitted with wire netting to hold the globe together in case of breakage.

Small Motor-Generator Sets.

THE SMALL POWER DYNAMO & MOTOR CO., of Old Lane, Openshaw, Manchester, have placed upon the market a compact motor-generator set, consisting of one of their semi-enclosed D.C. motors coupled to a semi-enclosed D.C. generator, both mounted upon a common bed-plate. We understand that a special feature of the machines is the coupling, which combines both a rigid and noiseless connection with perfect self-alignment, thus preventing any possible strain on the bearings. The set is specially recommended for economical cell-charging, electro-plating, copper depositing, &c., from supply mains. It can be supplied for any standard voltages from 100 to 250, with an output at the generator end of 40, 60, 100, 150, or 250 watts. The makers are also able to supply the machines, with the same outputs, to work with alternating current. They have issued a price-list containing particulars of the sets, and they will send copies thereof on application.

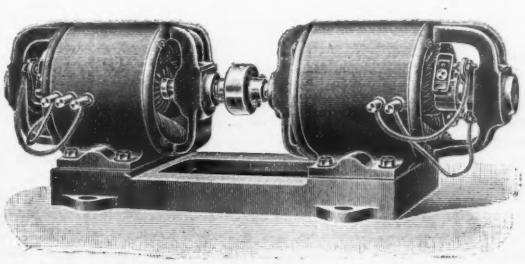

FIG. 2.—DIRECT-CURRENT MOTOR-GENERATOR.

New Demand Indicator.

MR. W. W. LACKIE, chief engineer to the Glasgow Corporation Electricity Department, has just patented a new maximum demand indicator, which will shortly be put on the market. It combines meter and indicator in one case, in this way saving space and first cost. The device may be given any time lag, and can be fitted to any motor meter. The arrangement, shown in position in fig. 3, and in diagram in fig. 4, consists of a beam A pivoted at D, having a plunger B at one end working in a coil C, and a small toothed wheel S at the other end. A balance weight W slides along an index beam, being moved by a stop N attached by a wire to the pinion S. The coil C is connected in series with the meter, and on a current passing, the plunger B is pulled down; the other end of the beam tilts up, causing the pinion S to gear with

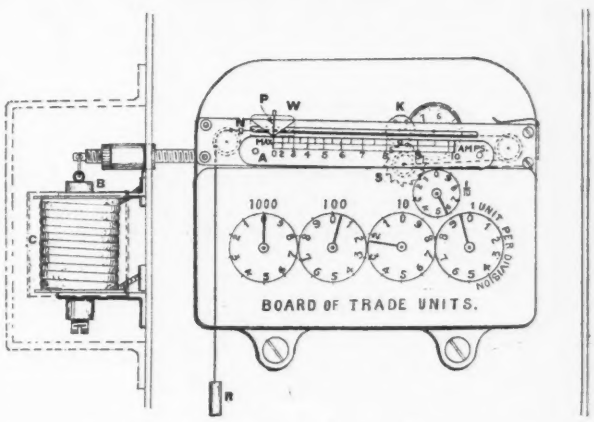

FIG. 3.—GENERAL ARRANGEMENT OF INDICATOR.

the wheel K of the counter mechanism. This wheel K causes S to rotate and wind up the wire with the stop N, which, in turn, carries the weight W along the beam A until it reaches such a position as to overcome the pull of the plunger B, when S falls out of gear. The small weight R suspended at the other end of the cord unwinds the cord from S, the stop N going back to zero position, and leaving weight W in a position corresponding to the strength of the current as shown by pointer P on a graduated scale marked on the

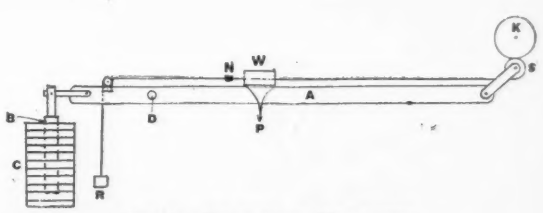

FIG. 4.—DIAGRAM OF MECHANISM.

beam. When a greater current goes through coil C, the wheel S gears once more with K, but the cord has to be wound up from its former position before the stop N can carry the weight W any further. This arrangement gives a time lag, the time taken to record any current being practically the same in each case. Short-circuits have no effect on this instrument, and it is said to have many other advantages over the thermal type of maximum-demand indicator.

Leitner Electric Ignition and Lighting System.

We recently inspected a new system brought out by the ACCUMULATOR INDUSTRIES, LTD., for use with any motor-driven vehicle, for supplying current for lighting, ignition, braking, or any other purpose. Essentially it consists of a "Leitner" variable-speed dynamo, an automatic switch and a small battery of accumulators. The dynamo, which is simply a small edition of the Leitner train-lighting dynamo, is of the smallest possible dimensions consistent with substantial construction and efficiency. It is driven either directly or by gearing from any of the revolving parts of the vehicle, and furnishes current to a battery at practically constant voltage over a very wide range of speed. Its capacity is 50 to 60 watts at normal full load, and it is dust-proof, and, as far as possible, fool-proof. When the dynamo is at rest, current is

supplied to the lamps, ignition apparatus, &c., by the battery; when the vehicle starts, the dynamo excites itself at a very low speed, and directly the voltage is sufficient the automatic switch, which is actuated by the difference in voltage between the dynamo and the battery, connects the two latter directly and puts a resistance in series with the lamps to prevent their being over-run. The apparatus was shown at work, and answered admirably; the dynamo cut in at a crawling speed with hardly a flicker, and the voltage remained sensibly constant at all speeds, while the lamps

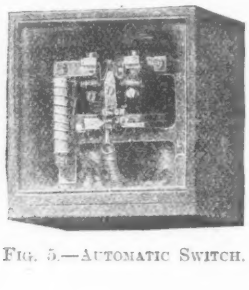

Fig. 5.—Automatic Switch.

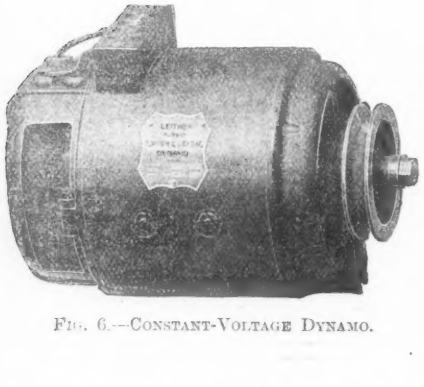

Fig. 6.—Constant-Voltage Dynamo.

and the ignition apparatus could be cut off or put on at pleasure. The battery is always kept charged, and therefore may be a small one and have a long life, but it is capable of running the lamps and ignition for two hours without aid from the dynamo. To prevent over-charging, it can be cut off in daylight hours, except when the engine is to be started up. Absolutely no attention or regulation is required, apart from occasional lubrication of the bearings, and, rarely, adding water to the cells. Leitner cells are used, with patent bead sp. gravity indicators to show the state of charge. The robust construction of the whole outfit is very commendable. Besides motor-cars, motor-boats can be equipped, and many uses can be suggested for this well-worked-out system. The accompanying figs. 5 and 6 show the dynamo and switch.

BUSINESS NOTES.

Twin Lead-Covered Wiring.—In our issue dated October 5th, 1906, we described a system of lead-covered wiring brought out by Messrs. Berry, Harrison & Co., the object of which was to overcome the difficulties appertaining to ordinary lead-covered wiring work. The system was described by Mr. E. L. Berry before a meeting of the London Section of the Electrical Contractors' Association, when certain criticisms were offered by the members present.

The inventors, if the system can be described as an invention, have profited by the suggestions and criticisms then made, and have also designed several new joint-boxes to deal with various wiring arrangements.

Thus, one of the boxes is for use with two switches which are to control one fitting; another, for use when one switch controls four wiring points; and a third for use when two switches control lights in each of three wiring points.

One of the criticisms levelled against the system before, was, that the brass saddles would not make sufficiently good earthed contact on to the lead, and, further, that there was danger of electrolytic action between the brass and the lead. These objections are met by tinning all the saddles and contact plates, and by providing an open slot in the top of the saddles which can be filled up level with solder, so soldering the clip on to the lead covering, and in this way making a perfect metallic joint.

Joint-boxes, saddles, earthing plates and clips, have been standardised, and a special form of lead wire cutters got out, and the boxes and their accessories are now being put on the market by the Accessories Manufacturing Co., Ltd.

Although Messrs. Berry, Harrison & Co. have fitted up several installations on this system they are not yet prepared to say exactly how the cost of the whole installation compares with other methods, such as casing and pipe work. Whilst it is cheaper than piping, it way be slightly dearer than casing work, but is considered to be a very much superior job.

Those interested in the system can obtain price list of the accessories from the Accessories Manufacturing Co., Ltd., 9 and 10, Wells Street, Oxford Street, W.

Annual Outing.—On Saturday, June 22nd, in delightful weather, the annual outing of the employés of Simplex Conduits, Ltd., took place at Bewdley. There was a good gathering (about 200), including a fair sprinkling of the company's district representatives and agents, but the unavoidable absence of the managing director, Mr. L. M. Waterhouse, was much regretted. The earlier part of the day was taken up by various sports and races; luncheon followed, at which the prizes were presented by Mrs. Brooks, the wife of the secretary of the company. The party spent the remainder of the day in boating trips, &c., on the River Severn.

Exhibition.—An Ironmongery and Hardware Trades Exhibition and Market is to be held at the Royal Agricultural Hall, Islington, from July 9th to July 19th. It is being promoted by the Ironmongers' Federated Association, Inc., who cordially invite members of allied trades to visit this their first exhibition.

Copper.—The mid-monthly report from Messrs. Merton's shows the situation practically unchanged, except that continued holding off on the part of buyers has taken the peak off the price, now down to £96 per ton. Supplies do not show any remarkable advance, the American shipments to other English ports being low for the fortnight; Spanish and Australian to England well maintained. Total stocks 5,381 tons against 5,879 on May 31st; visible supplies 11,181 tons against 11,729. Re-shipments for the fortnight are not recorded. America appears to be in a fair way to consume its supply, the shipments from this source tending rather to decrease than increase.

Consular Notes.—France.—The British Vice-Consul at La Rochelle (Mr. C. J. H. Hamilton) reports that a scheme for the distribution of electric light and power in the town of La Rochelle is likely to mature before long, and in this case there may be an opening for small electric motors suitable for use in workshops of various trades. Mr. Hamilton also remarks that the large number (some hundreds) of co-operative dairies in that district must employ a great many milk separators as well as other machinery. (*Foreign Office, Annual Series*, 3,812.)

School Installation.—It was reported at the meeting of the Metropolitan Asylums Board on Saturday that the electric lighting at the Downs School had been installed by Messrs. Dargue, Griffiths & Co., at a cost of £2,291. The contract price was £2,407.

Trade Announcements.—The interests of the English edition of *Cassier's Magazine* have been acquired by a number of people, amongst whom the following gentlemen will act as directors:—Mr. C. S. Vesey Brown, M.Inst. C.E., M.I.E.E., of Milburn House, Newcastle-upon-Tyne, chairman; Mr. W. H. Butlin, B.A., K.I.C., Spain, Mem. Iron and Steel Institute, and managing director of the firm of Thomas Butlin & Co., Ltd., and the Northamptonshire Direct Castings Co., Ltd., both of Wellingborough; and Mr. E. G. King, of 33, Bedford Street, Strand, London, W.C. The magazine will be conducted as heretofore under the general management of Mr. King, as managing director, who for a number of years was associated with the late Mr. Louis Cassier, and in the latter's absence conducted the editorial department. Mr. P. G. Cook will continue to act as advertisement manager. The editorial and publishing offices will remain at 33, Bedford Street, Strand, London, W.C., which will also continue to be the registered offices of the Louis Cassier Co., Ltd.

The Electric Ignition Co., Ltd., of Birmingham, manufacturers of the E.I.C. electrical specialities, have recently made some extensive alterations to their premises, including the building of an elaborate test shop.

Messrs. Wright & Wood, of Halifax, have appointed Messrs. Fletcher & Eaton, of 79, West Regent Street, Glasgow, as their sole agents for that city; also Messrs. Norrie & Co., of 7, Ward Road, Dundee, as their sole agents for the east coast of Scotland. We understand that the firm is turning out a largely increasing number of both continuous and single and polyphase motors. Both types of machines have recently been re-designed on the most up-to-date principles, with liberal rating and large overload capacity. Particulars and prices can be had on application to the firm. Inquiries in Glasgow and east coast of Scotland should be addressed to the above agents.

The British Thomson-Houston Co., Ltd., have opened a new branch office in Middlesbrough, in the Maritime Buildings, Albert Road. Telephone, "814, Middlesbrough;" telegraphic address, "Asteroidal, Middlesbrough."

Messrs. Richardsons, Westgarth & Co., Ltd., are removing their London office from the City to new offices at 5, Queen Anne's Gate, Westminster, S.W.

Messrs. F. Pooley, M.I.E.E., and F. Clifford Austin, have commenced business as Pooley & Austin, at 25, Victoria Street, S.W., as suppliers of general electrical and mechanical requirements. Both gentlemen have been connected with the electrical profession or business for some 15 years.

Mr. Thomas H. Toy, of 17, South Street, Finsbury, E.C., manufacturers' agent for glassware, gas and electric fittings, has discontinued that business and is transferring his services to Messrs. A. Emanuel & Sons, Ltd., engineers' merchants and manufacturers, 13, George Street, Manchester Square, W., as manager and buyer of their gas fittings department.

Messrs. Harris, Lee & Co., Ltd., have removed their London office to 55, Berners Street, Oxford Street, W. Their telephone number remains unaltered.

The liquidator of the A.B.P. Accumulator Co., Ltd., notifies that, in consequence of the acquisition of the stock, patents and goodwill of the company by Messrs. Pritchetts & Gold, Ltd., all communications should be addressed to the latter company at 20, Victoria Street, S.W.

Dissolutions and Liquidations.—Patent Exploitation, Ltd.—A petition, presented by the Electrical Power Storage Co., Ltd., for the winding up of this company is to be heard at Liverpool on July 12th.

Scottish House-to-House Electricity Co., Ltd.—A meeting is to be held at Moorgate Court, E.C., on July 26th, to hear an account of the winding up from the liquidator, Mr. H. B. Renwick.

Meetings will be held to receive the liquidators' reports in connection with the following companies: Weldite, Ltd. (July 19th), and South-Western Electrical Co., Ltd. (July 22nd).

Book Notices.—*Elementary Electrical Engineering.* By J. H. Shaxby, B.Sc. London: Blackie & Son. 1907.—This book is written to help those who desire to obtain a simple explanation of the principles on which the theory of electrical machinery is based. The explanations given are clear, and the diagrams and printing are very good. It will be found useful to those for whom it is written.

"Impianti Elettrici a Correnti Alternate." By A. Marro. Milan: Ulrico Hoepli. 1907.

For Sale.—Messrs. J. R. Woodley & Co. are offering for sale by tender the stock of Hale Bros., wholesale electricians, Upper Thames Street, E.C. See our advertisement pages for particulars.

The Tynemouth Corporation is inviting offers for the purchase of an automatic reversible booster and switchboard, which are referred to in our business pages to-day.

Electrical Imports from the U.S.A.—It was stated in Parliament last week that the figures for electrical machinery were omitted from the Annual Trade Returns for 1906, for the years 1903 and 1904, from the item "all other kinds of machinery." The figures were £305,563 and £289,973 respectively, making the corrected entries under this heading £1,848,043 and £1,658,126 respectively.

Cooling Towers.—We understand that Messrs. Balcke & Co., of 27, Clement's Lane, E.C., have just received orders as follows for their cooling towers:—

For Fraser & Chalmers, Ltd., Erith, for new works, one chimney cooling tower for 90,000 gals. per hour.

For the Duffryn Rhondda Colliery Co., Port Talbot, one ditto, for 100,000 gals. per hour.

For the Whitworth Collieries, Port Talbot, for new works, ditto, for 92,500 gals. per hour.

For the Diesel Engine Co., Ltd., London, for Vera Cruz, one open type cooling tower for 20,000 gals. per hour.

Bankruptcy Proceedings.—Edgar Peckham.—The public examination was held last week at the London Bankruptcy Court, before Mr. Registrar Brougham, of Edgar Peckham, described as lately a director of public companies, Queen Anne's Chambers, Westminster. The statement of affairs showed total liabilities £4,592, of which £1,732 is expected to rank, against assets valued at £1,742, after deducting £60 for the preferential claims. Under examination by Mr. Walter Boyle, assistant Official Receiver, the debtor stated that he was an American citizen, and came to London from New York in August, 1904, partly for the benefit of his health, and also to represent the Peckham Manufacturing Co., of Kingston, New York, for the sale of electric trucks for tramcars; he was managing director of the company at a salary of $10,000 per annum, and held this position until the liquidation of the company in May, 1905. Since the liquidation he had been engaged developing and inventing improvements in trucks and gears for electric tramcars, and the patents taken out by him are charged to creditors treated as fully and partly secured. In February, 1905, he purchased the assets of the "Malleable Steel Castings Co.," of Manchester, from the liquidator for £1,650, paid for as to £50 in cash, £600 by his acceptances, and £1,000 of debentures of a new company formed by him in January, 1906, called "The Malleable Steel Castings Co. (1906), Ltd." As vendor he was to receive 3,000 £1 shares of the company, with the appointment of managing director, at a salary of £40 per month, and the company also agreed to repay him the purchase price of the assets of the company. The undertaking was not a success; he was unable to meet his acceptances for the £600 before mentioned; he was sued in respect of them, and after judgment had been obtained against him, the judgment creditor presented the petition on which the receiving order was made. Witness attributed his insolvency to the failure of the Peckham Manufacturing Co., and to the non-success of the Malleable Steel Castings Co. (1906), Ltd. The examination was concluded.

C. W. Stafford (Stafford Bros.), electrical engineer, Ocker Hill, Tipton.—A receiving order was made at Dudley on June 15th on debtor's own petition. First meeting of creditors, July 4th; public examination, July 12th; both at Dudley.

Catalogues and Lists.—The Dartium Syndicate, Ltd., 28, Basinghall Street, E.C.—Twenty-page pamphlet describing the Dartium steel process and how to make steel castings and tool steel in the ordinary iron or brass foundry by means of Dartium.

Messrs. Richard Hornsby & Sons, Ltd., Spittlegate Ironworks, Grantham.—New list of users of their large power "Hornsby-Stockport" gas engines; also a pamphlet describing their patent suction gas plant, and giving an imposing list of users of same. It is interesting to note from the first two items in the list that 17 plants of large size (11 of 66 B.H.P. each and six of 115 B.H.P. each) are for pumping purposes for irrigation works on a large scale in Egypt. A glance through the list shows that a fair percentage of the plants have been supplied for small electrical installations.

Messrs. E. P. Allam & Co., 11, Red Lion Street, Clerkenwell, E.C.—New edition of their catalogue, containing illustrations, brief particulars and tabulated prices, sizes and code references, of "Premier" electric motor-control apparatus. In addition to their standard pattern of motor starters, they have included various new patterns, among them being one minute pattern starting switches, starter regulators, reversing starting switches, automatic self-starters, Universal motor control panels, and small power motor starters. Any member of the trade can have a copy of this publication upon forwarding trade card to the firm.

C. W. Hunt Co., West New Brighton, New York.—Pamphlet No. 073, being a small pocket pamphlet giving small illustrations and a few notes, serving as an introduction to the general line of their manufactures.

Messrs. David Bridge & Co., Castleton Ironworks, Castleton, Manchester.—Latest publication (40 pages) giving information printed in English, French, and German, relating to their india-rubber, gutta-percha and balata machinery, including friction clutches, haulage plants, mill gearing, ice crushers, oil separators, boiler feeders, couplings, &c. The pamphlet is intended as a supplement to the firm's catalogues previously circulated. Many large and clearly printed illustrations of the above lines of manufactures appear. Messrs. Bridge will forward copies to those interested on application.

Messrs. E. A. Brandon & Co., 33, Devonshire Chambers, Bishopsgate, E.C.—Circular relating to the Sherardising patent process of the London Sherardising Co., Ltd. (for whom they are sole selling agents), by which steel or wrought and cast-iron are protected from rust.

Messrs. Veritys, Ltd.—New catalogue. No. 552, relating to their main switches. The "T.B.K." twin-blade quick break knife switches—an already known type—is fully particularised, and a new type is listed which is now being put on the market—namely, the "S.C.K." The special features of this switch may be mentioned. In the ordinary knife switch of the "T.B.K." type the two contact faces composing the jaw are fixed rigidly at their root, but in this type, while one contact has a rigid casting, the other is flexible and free to move, so that it always makes perfect contact with the blade as the latter enters the contact. In the twin-blade knife type of switch, should the blade be a little thicker or a little thinner than the space between the contacts provided for it, the two contacts will either spread apart, making contact only with the bottom edge of the blade, or where the blade is too thin, making contact only with the top edge. A general description and brief specification of the switch are given, also instructions for mounting, dimensional diagrams, prices, &c.

The Chloride Electrical Storage Co., Ltd., Clifton Junction, Manchester.—New circular, No. 19, giving particulars (illustrated) of their "P.G." and "L.G." types of the Chloride accumulator for use in connection with small country house, &c., electric lighting plants.

LIGHTING and POWER NOTES.

Ashton-under-Lyne.—A L.G.B. inquiry was held on June 19th into the application of the T.C. for a loan of £17,000 for extensions to the electricity works, and £700 for additions to the refuse destructor. There was no opposition.

Beckenham.—A L.G.B. inquiry was held last week regarding the U.D.C.'s proposed loan of £5,460 for the purchase of that part of the undertaking of the South Metropolitan Electric Light and Power Co., which is in the district of Beckenham.

Belfast.—On the 20th inst., Mr. A. D. Price conducted an inquiry into an application of the Corporation for a loan of £98,000, including a sum of £75,000 for the extension of the electric lighting system. Mr. V. A. H. M'Cowen, formerly of Belfast, said that the extensions were recommended by him. The undertaking was sound financially, and the plant required included steam dynamos, condensing plant, boilers, superheaters, mechanical stokers, economisers, pumps and pipe-work, and the estimates also included the laying of a network of mains in the Malone district. The proposed plant was of the most up-to-date character. Mr. T. W. Bloxam, electrical engineer to the Corporation, gave corroborative evidence.

Bexley.—The L.G.B. has forwarded to the U.D.C. sanction to a loan of £6,293 for E.L. purposes.

Bradninch.—It is proposed to introduce electric light into this village (seven miles from Exeter), and some existing water turbines will possibly be utilised in connection with the scheme.

Bury (Lancs.).—A L.G.B. inquiry was held on June 18th into the application of the T.C. for a loan of £22,500 for extensions to the generating plant.

Carmarthen.—With regard to the contract with Messrs. Saunders & Co., of Cardiff, to light the town by electricity, the T.C. has decided to insist upon the maximum price in the prov. order being 5d. per unit, and not 8d., as desired by the firm, with a proviso that no more than 5d. should be charged without the consent of the Council. The period for completing the installation is to be extended from twelve to eighteen months.

Carnarvon.—The T.C. has adopted an alternative free wiring scheme under which consumers will pay an additional rate of ¾d. per unit in lieu of the fixed rental of 1s. 6d. per lamp per annum.

Cleckheaton.—The annual report of the electricity undertaking of the Council again shows a loss. The total loss for the two years since the establishment of the undertaking amounts to £980, which is nearly equal to a rate of 5d. The increase in the demand for any purpose outside of tramway traction is reported to be very slow.

Continental Notes.—Italy.—As a result of a conference between the undertakers and the authorities of the City of Turin, an important alteration is to be made in the Salbertrano Canal, now under construction, whereby it will be possible to complete the work by December, 1908. A tunnel is to be cut through the mountain instead of a more circuitous route. The undertakers are to be paid 200,000 lire above the contract price, plus 1,000 lire per day that the canal is finished before the original date of June 1st, 1909, when it ought to have been completed under the first scheme.

A company is now being formed to use the waterfall of the Deserdan torrent, near Fostogna. It appears that a power of 1,000 H.P. is available, a part of which would be used at some cotton works and at an acid factory, the rest of the energy being available for electric lighting. The estimated cost of the undertaking is 400,000 lire, say, £16,000.

The authorities of the province of Novara have granted a concession to put down a plant to utilise the water-power of the River San Bartolomeo delle Valle at San Bartolomeo Balmara, for the generation of electrical energy for lighting and power purposes.

Germany.—The municipal authorities of Stuttgart are about to invite tenders for the establishment of a central electric lighting station near Munster, at an estimated cost of £75,000.

Exeter.—The accounts of the electricity department for the year show, after making provision for interest and sinking fund and depreciation, a net surplus of £1,403, which is to be transferred to reserve account, making it £3,040. There has been an expenditure on works at the new power station of £2,588 in excess of the approved loan. Instead of applying to the L.G.B. for sanction to an additional loan on capital account to meet this expenditure, the Committee propose to discharge this liability out of income. They, therefore, debit the reserve account with this £2,588, thereby reducing the credit balance on the reserve account to £420. The electrical engineer reports that the total receipts for the year were £16,382, and the working expenses £8,004 10s., leaving a gross profit of £8,378. The interest and sinking fund charges amount to £6,974. The units sold were 1,191,233. The Council have now owned the undertaking for a period of ten years.

Finchley.—The D.C. recently engaged Mr. A. H. Preece to report upon the electricity undertaking generally, including proposals with regard to bulk supply and extensions.

Gainsborough.—The U.D.C. has been recommended to acquire a site for the provision of a refuse destructor to be worked in connection with the proposed E.L. works. The B. of T. has informed the Council that something definite will have to be done at once with respect to the E.L. order.

Gillingham (Kent).—The T.C. has entered into an agreement to supply current to the Royal Naval Hospital for three years, at 2¾d. per unit on the flat rate.

Gravesend.—The Corporation has resolved to take no further action under the Gravesend E.L. extension to Northfleet order, 1905.

Harrington.—The U.D.C. has accepted the offer of Messrs. J. Bain & Co. to light the streets of Lowca by electricity at £1 10s. per 16-C.P. lamp from September 1st to April 30th.

Hastings.—The T.C. on Friday decided to revise the price of energy to large consumers as under:—Over 250 units per quarter and under 500, 5¾d. per unit; 501 to 750, 5½d.: 751 to 1,000, 5¼d.; 1,001 to 1,250, 5d.; 1,251 to 1,500, 4¾d.; 1,501 to 2,000, 4½d.; beyond, 4¼d. For outside lighting with arc lamps, &c., on a three years' agreement, 4½d.

Hull.—The T.C. has entered into an agreement to supply energy for power at the works of Messrs. Reckitt & Sons, Ltd., Stoneferry. The firm will take 150,000 units per annum, and the cost of cables will be £746. Negotiations are proceeding for a supply of 100,000 units per annum to the Union Cold Storage Co., the minimum rate to be 1d. per unit.

Kingston-on-Thames.—The T.C. has decided to supply current for motors to the works of Kelly's Directories, Ltd., at 1½d. per unit up to £150 per annum, at 1¼d. per unit for the next £100 per annum, and at 1¼d. per unit beyond. Current for lighting is also to be supplied to the Royal County Theatre on a three years' agreement at 4¼d. per unit, with a minimum payment of £1,050.

Leyton.—The electrical engineer recently reported upon the necessity of installing a third generating set (£4,000), consisting of engine, dynamo, condenser and accessories. The E.L. Committee sought authority to advertise for tenders therefor. An amendment was, however, carried in the Council by 14 votes to 9, deleting the paragraph. The mover of the amendment objected to the expense involved, and expressed the opinion that the L.G.B. would not sanction the necessary loan. It was said by others that all that was required was an extra armature, but the engineer in his report had shown that this would not ensure ability to supply in the event of one engine being under repair, and the armature of the other set burning out, as it would take a day to change the armatures. He also referred to the uncomfortable experiences they were having in connection with the dynamos, which were the reason for his laying the exact position of affairs before the Council. If anything goes wrong now the Council must accept entire responsibility.

Llansamlet.—A committee has reported to the Council on the proposed utilisation of the Glanbrane water course in connection with the electric lighting scheme. The Council is inquiring regarding its powers in the matter before proceeding further.

London.—Deptford.—Permission has been granted by the B.C. to the London Electric Supply Corporation, Ltd., to lay a main for low pressure supply in Brockley within 1 ft. of the building frontages on condition that the company agrees to make good any damage.

Battersea.—The Comptroller of the L.C.C. has written to the B.C., suggesting the reconsideration of an application for sanction to a loan of £2,270 for lighting by electricity the roads on the Park Town Estate. The communication says:—"It has been reported to the Finance Committee that 12 out of the 14 streets are unimportant side streets, and having regard to the heavy cost of installing electric light, and to the fact that little, if any, use would be likely to be made of the mains for private supplies, the Committee do not view the application for the loan with favour. I am directed to inquire, further, whether the Borough Council have considered the relative cost of lighting the streets with gas and electricity." Up to June 18th there were 988 consumers for lighting connected with the mains, representing 65,878 8-C.P. lamps; for motive power the equivalent of 1,332 H.P. was supplied, and for public lighting the equivalent of 6,264 8-C.P. lamps was supplied. The increases during the quarter were: Lighting, 21 consumers, 1,169 8-C.P. lamps; motive power, 209 H.P.; public lighting, 664 8-C.P. lamps.

The B.C. Lighting Committee has pointed out that the periods for the loans which have been granted for electricity purposes to the Borough are as follows: Land, £8,540, 60 years; land, £13,900, 52 years; buildings, £58,858, 50 years; mains, £72,023, 20 years; machinery, £100,502, 20 years; meters, £5,002, 10 years; total, £258,825. The burden on the revenues is far in excess of that prevailing in other boroughs, where, in most cases, the bulk of the loans are repayable within 42 years, and the L.C.C. are to be asked whether they could see their way to rearrange the periods in respect of loans which they have granted to Battersea for electric lighting purposes, so that the periods of repayment may be the same as have been granted to other local authorities, particularly in the case of mains and machinery. A strong protest is to be made against the proposed fees of the L.C.C. in respect to the duties performed by their inspectors in visiting testing stations established in the county by electrical undertakers under the provisions of special Acts or provisional orders.

St. Pancras.—It is reported that the Electricity Committee of the Borough Council has expressed a strong opinion that no further amounts should be allotted from the profits of the electricity undertaking for the relief of rates until one-tenth of the aggregate capital expenditure on the undertaking has been reached, as prescribed in the Council's electric lighting order.

Stepney.—At the last meeting of the B.C., an amendment was carried on the question of increasing the engineer's salary conjointly with his taking charge of the Blyth's Wharf scheme. The amendment was to the effect that the matter should be referred back for the Committee to consider the advisability of engaging an expert.

Hackney.—The E.L. Committee has given notice to the Board of Trade of its objection to the charges proposed to be made by the L.C.C. for inspectors' fees; and it has convened a conference of the various borough councils to be held on July 1st.

Stoke Newington.—The B.C., in reply to a letter from the Shoreditch B.C., has decided to co-operate with a view to securing a re-adjustment of the powers for electrical supply in London, promoting a mutual exchange of supply between the different Councils and the L.C.C., which would demonstrate which is the cheapest source for future use and which would effect a saving in cost benefiting all the authorities concerned as well as their ratepayers and consumers.

WESTMINSTER.—The various electric light companies, having powers to lay mains in the streets, are to be requested to notify the City Council forthwith in the event of an explosion connected with their mains in any street in the city or any other defect in the electric system affecting the public lighting on the highways of the city.

L.C.C.—At the meeting on Tuesday, the Highways Committee reminded the Council of the approval given in January, 1906, to the laying by the County of London Electric Supply Co., of high and low-tension cables along portions of Peckham Grove, and two other streets in Camberwell. At the instance of the Camberwell B.C., the approval was accompanied by the condition that the consent should not apply to any works, pipes or wires, other than such as were to be used exclusively for the company's purposes under the Camberwell Electric Lighting Order, 1896. This condition was subsequently also attached to approval given to works in another road. An appeal in each case was made by the company to the Board of Trade, and an inquiry was held, the result now being an announcement that the Board had allowed the appeals.

Mansfield.—The L.G.B. has now sanctioned a loan of £584 in respect of wages paid to employés permanently engaged by the T.C., on condition that in future such payments will not be made out of loan monies. The sum had been excluded from a sum applied for last February.

Merthyr Tydfil.—The T.C. has accepted the tender of the Merthyr Electric Traction and Lighting Co., Ltd., for public lighting at Dowlais at £3 6s. per pair of Osram lamps per annum.

Newport (Mon.).—At a meeting of the Tramways and Electricity Committee on Tuesday, the accounts of the year's working were further considered. The electricity accounts showed a deficit after paying interest and sinking fund, and it had been decided to carry the deficit balance forward. The majority of the members were strongly opposed to making a call upon the rates, as they believe that with the increase of customers, and a reduction of working expenses, it should be possible to wipe out the adverse balance from profits in future years. The profit on the tramways is sufficient to wipe out the adverse balance previously carried forward.

Northfleet.—The U.D.C.'s prov. order was revoked in 1905, and a new order granted to the Gravesend T.C., but apparently nothing has been done by the latter. The B. of T. will, therefore, consider the revocation of the order if the compulsory works are not completed by August 11th next.

Plymouth.—The Electricity Committee has reduced the price of energy used between midnight and 3 p.m. from 2½d. per unit to 2d. For meters the present uniform charge of 10s. per quarter has been abolished, and a sliding scale ranging from 2s. 6d. to 10s. adopted.

Pontypridd.—The electrical engineer has reported to the U.D.C. on free wiring. He says it would be a great mistake to discontinue the use of it entirely. If it had not been for free wiring the Council would not have 110 consumers on its books, and the revenue from private consumers would have been at least 50 per cent. less. The Council should try to encourage the consumer to purchase his installation on the hire-purchase system by paying off the amount quarterly either in 4, 8, 12 or even 16 payments. The question was adjourned. The engineer also reported on the question of charges for electricity.

Port Elizabeth (S.A.).—The *Financial News* says that the municipality has decided to expend a further sum of £25,000 to complete the electric light installation for the city.

Portrush.—At a special meeting of the U.D.C., held on the 17th inst., it was decided to proceed with the electric lighting of the town. The specifications were prepared by Mr. John Woodside, A.M.I.E.E., Belfast.

South Shields.—The annual report of the Corporation electricity undertaking just issued by the electrical engineer, Mr. J. H. Cawthra, shows that the income on the revenue account was £22,700; and the expenditure was £9,398, leaving a gross profit of £13,302. In the previous year the income was £17,331, and the gross profit £10,120. During the year the total capital increased from £163,047 to £172,851. There is a net surplus of £3,139. The number of units sold has been 2,291,612, as compared with 1,438,921, an increase of 59 per cent. The total cost per unit has decreased from 2·63d. to 1·98d. Latterly the load factor has materially increased.

Sutton-in-Ashfield.—The Mansfield T.C. intends to apply for a prov. order for the district of the U.D.C.

Swansea.—The report of the Electric Lighting and Tramways Committee regarding the electric lighting station and finance is to be discussed at a special meeting.

West Ham.—The Electricity Committee has decided to ask Mr. W. Thorne, M.P., and Mr. Masterman, M.P., to support a motion for the reduction of the vote on the estimates of the Local Government Board, to be moved by the member for Sunderland, in order to obtain a discussion on the Board's action in deducting amounts paid as wages to permanent workmen in connection with work carried out under loans sanctioned by the department. The Borough Treasurer reported that the amount collectable up to March 31st, 1907, in respect of energy consumed up to December 31st, 1906, was £18,021, as against £16,575 for the corresponding period of last year, being an increase of £1,446. The amount actually collected was £17,364. Of the balance £410 was due to discount, £20 to allowances, and £181 to arrears, and £46 to irrecoverables. The percentage of irrecoverables on the total amount collectable was 25, and on the amount collected from private consumers 50.

Whitefield and Worsley.—The *London Gazette* for June 21st contains particulars of the proposed transfer of the Worsley U.D.C. prov. order of 1901, and the Whitefield U.D.C. order of 1900, to the Lancashire Electric Power Co.

Wigan.—The Electric Lighting and Tramways Committee has decided to ask the B. of T. to appoint two experts to inquire into the working of the electric lighting and tramways department, as a result of the financial loss incurred last year.

TRAMWAY and RAILWAY NOTES.

Electric Tramways and Railways Tables.—CHATHAM.—We regret that through a mistake the name of Mr. Gordon Davies, traffic manager, was substituted for that of Mr. W. Jensen, who is the general manager of the Chatham and District Light Railways.

Continental Notes.—ITALY.—The funicular railway from Santa Margharita, Lake Lugano, to Belvedere Point, Intelvi, has been completed in a satisfactory manner, and is ready for the official inspection which, it is hoped, will take place before the end of this month, after which the line will immediately be put into public service.

Croydon.—On Monday, in accordance with the terms of a through running agreement, the tramcars of the South Metropolitan Tramway Co. commenced running from the Crystal Palace, Penge, and Anerley, through South Norwood to West Croydon, and the Corporation's cars from West Croydon to Anerley, Penge, and the Crystal Palace.

Halifax.—The Tramways Committee of the T.C. has decided to abandon the proposed extension of the electric tramways to Wainstalls, Elland, Ripponden, Cragg Vale, and Stainland, the estimated cost of which was £190,000.

The electric tramways manager, Mr. F. Spencer, has been asked by his Committee to give his views on the best means to effect a reduction in the departmental cost of working the tramways. He has replied that the best means to effect a reduction is by supplying cheaper energy. He adds:—"The cost of power must always be an expensive item in Halifax. The present charges are 1·5d. per unit, as against Leeds ·76d.; Bradford, 1½d.; Huddersfield, ·68d.; and Leicester, ·60d. If the Halifax Tramways Committee could purchase energy on such advantageous terms as any of the towns named, the tramways undertaking would show a very handsome profit. The permanent way and electrical equipment of the line, amounting to ·893d., cannot be reduced, and an increased traffic cannot be induced by reducing facilities." He is strongly of opinion that to increase fares on any section would result in a diminished total revenue.

Liverpool.—The platforms at the stations on the L. and Y. Railway electric system are being raised by 11 in., namely at Southport, Birkdale, Ainsdale, Freshfield Highton, Hall Road, Crosby, Bootle and Bank Hall, so that passengers can board the trains more easily. At several of the stations the electric light has been installed. The electrical energy will be supplied through the medium of the "live" rail, and gas will be discarded.

South Africa.—NATAL GOVERNMENT RAILWAYS.—The annual report of the electrical engineer, Mr. F. W. Mills, M.I.E.E., for the year ended December 31st, 1906, is of an interesting character, showing, as it does, reduced costs of generation and increase of plant. The increase in plant is due to the unification of the Natal Harbour Board and the railway department since August 1st, 1906, whereby all current will be supplied from the railway power station; the contract for the additional plant is nearing completion, and we hope to describe it at a later date. Great success has attended the use of dross coal (Natal), which accounts, in a great measure, for the reduced costs of generation in some stations, as compared with the previous year's costs. There are nine stations on the system, seven of which generate their own current, the grand total of units generated being 1,845,991. Train lighting is increasing steadily, both by the van system of accumulators, and by the "Stone" system. In the van system there are 50 vans fitted with accumulators, the total annual cost for these including charging, being £100 18s. 6d. There are 412 coaches wired in connection with the vans; the average cost per train trip amounted to 7s. 2d. In the "Stone" system there are 73 coaches fitted, at a total annual cost of £35 14s. 3d., the average cost per train trip amounting to 4s.

Motor driving is still being extended in the various workshops; the H.P. of motors installed during the year amounted to 151

making a total of 2,074 H.P. The following table shows the costs of generation at the various stations, the figures being pence per unit:—

Station.	Units generated.	Coal.	Water.	Oil, waste, stores.	Salaries, wages, &c.	Total works costs. 1906.	Total works costs. 1905.
Dunban and Grayville ..	1,155,077	·075	·078	·227	·695	1·075	1·163
Hill Crest ..	75,909	·123	—	·124	1·618	1·865	2·231
Inchanga ..	35,999	·386	—	·199	1·550	2·135	6·488
Pietermaritzburg	319,436	·061	·089	·174	1·369	1·643	1·988
Mooi River ..	38,517	·167	—	·389	3·117	3·673	6·089
Ladysmith ..	136,804	·103	—	·166	2·460	2·729	3·220
Charlestown ..	84,249	·142	—	·304	2·834	3·280	5·667
Newcastle, Dundee	Supplied by local authority.						

Wimbledon.—A trial trip was made on 24th inst. over the new tram-lines through Wimbledon to Summerstown and Tooting. It was expected that the lines would be opened for traffic yesterday.

TELEGRAPH and TELEPHONE NOTES.

African Telegraphs.—The French Government has authorised the construction of a telegraph line between Timbuctoo and Niamey and Zinder. The length of the line will be 1,800 kilometres and the cost 2,000,000 fr.

Madeira.—According to a Consular report, the island is in great need of a telephone system, owing to its rugged surface, which renders communication slow and costly. The island has a population of 150,000, and a prosperous trade is carried on.—*B. of T. Journal.*

New Cable. — The new cable laid by the Spanish Administration between Barcelona and Palma has been opened for traffic.

Persia.—A Press tariff of 9d. per word has been introduced between Great Britain and Persia, *viâ* the route of the Indo-European Telegraph Co., and will come into force on the 1st prox. The rate is not applicable to Bushire.

Telegraph Bill.—On the second reading of the Telegraph (Money) Bill, Mr. Buxton, the Postmaster-General, said that the State had expended £3,400,000 on trunk telephone lines, £2,600,000 on the London telephone system, and £500,000 on provincial exchanges. The total mileage of telephone wires under the control of the Post Office was 328,000 miles. The Bill authorised the expenditure of £2,800,000 on the trunk system, £1,800,000 on the London system, and £1,050,000 on provincial exchanges, raising the total outlay to £13,300,000. The trunk system and the London business were carried on at a profit, but there was a loss on the provincial exchanges. The total profit last year was £37,200, after allowing for interest at 3 per cent. and depreciation.

Telegraph Wires and Local Rates.—In reply to questions in Parliament, the Postmaster-General admitted last week that telegraph and telephone wires were not assessed for local rates, but stated that the trunk telephone wires acquired from the National Telephone Co. in 1896 were rated.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Cayenne-Pinheiro	.. Aug. 18, 1902 ..	..
Curacao-Coro, Curacao-La Guayra, Curacao-Maracaibo — Closed..	.. Jan. 12, 1906 ..	..
Reissa-Issa and Reissa-Yemani (Yemen) ..	.. Oct. 22, 1902 ..	..
Tarifa-Tangier	.. Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)	.. Mar. 9, 1904 ..	..
Garachico-Santa Cruz	.. July 12, 1906 ..	..
Las Palmas-Arecife	.. Aug. 18. 1906 ..	..
Trinidad-Demerara	.. June 17, 1907 ..	June 22, 1907
Landlines.		
Puerto-Barrios	.. Aug. 2 , 1902 ..	..

Telephone Charges.—The Postmaster-General's attention having been called to the new tariff issued by the National Telephone Co., whereby all unlimited tariffs for business purposes are withdrawn, he stated that experience had shown that this rate was not profitable, and that it tended to encourage subscribers to originate more calls than their lines would carry without blocking inward calls, thus rendering the service less efficient. The general demand in this country, as in America, was now for a measured service, which proportioned the payment to the service obtained and allowed moderate rates to be given to small users. An average of twenty calls a day originated by any subscriber would, if due allowance were made for a corresponding number of inward calls, be more than one line could carry, and two lines would properly be required. Under the new tariff at the private branch exchange rate two exchange lines and the right to originate 6,000 calls would cost £21 10s., which is at the rate of about 14 calls for 1s., and the charge for additional calls would be at the rate of less than ¼d. each.

Telephone Convention.—An important convention of telephone men, attended by about 1,000 delegates from the United States and Canada, has been held in Chicago this month.

Telephone Directory.—New telephone subscribers now come on in such large numbers that a more frequent issue of the directory is desirable, and in future the National Telephone Co. will publish a complete directory twice a year. The new directory will be ready early in July.

Wireless Telegraphy.—On the application of the plaintiffs, and by consent of the defendants, the action lately brought by the Lodge-Muirhead Wireless and General Telegraphy Syndicate, Ltd., against Marconi's Wireless Telegraph Co., Ltd., for slander of title has been dismissed.

CONTRACTORS' COLUMN.

Openings for new Business.

BEXHILL-ON-SEA.—Extension of Town Hall (£2,750). Henry Ward, architect, 8, Bank Buildings, Hastings.

BOLTON.—Alterations and extensions to Mytham Road Mills, Little Lever.
Additions to bleach works for Messrs. Slater & Co.
Additions to Makant's works.

BRADFORD (Muff Field).—Wesleyan Reform Sunday Schools (£4,000). Walker & Collinson, architects, Cheapside Chambers, Bradford.

BRIERFIELD (Lancs.).—Extensions to Meadow Bank Mills for J. Halstead and Co.

BUCKHAVEN.—Public slaughter-house. Mr. Telfer, architect.

BURY (Lancs.).—Operating theatre, &c. (dispensary theatre). Herbert Nuttall, architect, 20, Market Street. Bury, Lancs.

CASTLEFORD.—Secondary schools (£11,434). W. S. Braithwaite, architect.

CATERHAM.—Additions to asylum. W. T. Hatch, Metropolitan Asylums Board Offices, Embankment, E.C., engineer.

CHESTER-LE-STREET (Pelton).—Council schools. J. W. Hanson, architect, 79, King Street, South Shields.

COLNE (Lancs.).—Enlargement of weaving sheds. Secretary, Swansfield Weaving Co., Colne.

COVENTRY.—New factory at Spon End. Coventry Chain Co., owners.

CREWE.—Secondary school (seating 350). H. Beswick, Country architect, Newgate Street, Chester.

DERBY.—Nurses' home at the Workhouse. F. C. Coulthurst, architect, 4, Albert Street, Bury.

DONCASTER (South Elmsall).—Flour mills. Mr. Parkinson, contractor, Doncaster.

DUDLEY.—New Wesleyan church. W. F. Edwards, architect, Blackheath (Worcestershire); J. Harper & Sons, builders, Blackheath.

EPSOM.—E.L. installation at the Workhouse.

GRANTHAM (Carlton Scroop).—Residence, Willoughby Hall. Wood & Sons, builders, Derby.

HARPENDEN (Herts).—New church for St. John's parish (£3,287). Phillips and Blake, builders, Harpenden.

HASLINGDEN.—Infirmary (£30,000) and new Guardians board room and offices (£5,600). Mr. H. Ross, architect, Accrington.

HOUGHTON-LE-SPRING (Co. Durham).—Public schools. W. & T. R. Milburn, architects, 20, Fawcett Street, Sunderland.

HUDDERSFIELD (Denby Dale).—Chapel for the Wesleyan Reform Church. P. A. Hinchliffe, architect, 14, Regent Street, Barnsley.

HYDE.—New Public Schools (£12,500). Jas. Lindley, architect, Hyde; S. Robinson and Sons, builders, Hyde.

KNOTTINGLEY.—New Wesleyan Sunday school (£2,600).

LANCASTER.—New Council school. H. Littler, county architect, Preston.

LEE.—128 houses. G. A. Lansdown, 9, Regent Street, W., architect.

LEEDS (Yeadon).—Villa residence for Mr. C. A. Ives. H. Chippendale, architect, Guiseley, near Leeds.
New church, St. Margaret's (£8,000). Temple Moore, architect, Leeds; Henry Atkinson & Sons, builders, Carlton Hill, Leeds.

LONDON (Hammersmith).—Extensions to premises of General Builders, Ltd., Wharf Road, Latimer Road (probable installation of electrical machinery).
(Battersea).—Additions to Belmont Works, York Road, for Price's Patent Candle Co., Ltd.
(Camberwell).—Additions to St. Joseph's R.C. school, Pitman Street.
(Elgin Avenue, W.).—Buildings. A. Young, 35, John Street, Bedford Row, W.C., architect.
(Hackney).—Secondary school (£9,019). T. J. Bailey, architect, Education Committee, L.C.C.
(Holborn).—Re-building Macklin Street R.C. school (£10,000).
(Kennington).—Alterations to St. John's School (£2,000).
(New Southgate).—Additions to Colney Hatch Asylum (£62,000). W. C. Clifford Smith, 6, Waterloo Place, W., engineer.
(Bromley.)—Alterations and additions to asylum. J. and W. Clarkson, 136, High Street, Poplar, architects.
Wandsworth.—Additions to workhouse. C. A. Sharp, 11, Old Queen Street, Westminster, architect.
(Southwark).—Day room and workshed at workhouse. H. C. Jones, clerk to Guardians, John Street West, Blackfriars, S.E.
(Stoke Newington).—Workshops in Manor Road for W. Osment, manufacturer of joinery, Northwold Road, Upper Clapton, N.E.
(Finsbury).—Working class dwellings in John Street and Rawstorne Street. A. Kent, 83, St. Paul's Churchyard, E.C., architect.
(Strand).—Building on site of Crown Hotel, St. Martin's Court. W. G. R. Sprague, 10, Jermyn Street, S.W., architect.
(Oxford Street).—Alterations and structural improvements to Princess's Theatre. W. G. R. Sprague, architect.
(Oxford Street).—Alterations and additions to Frascati's restaurant. R. Blomfield, New Court, Temple, E.C., architect.
Hampstead.—Extensions and alterations at 42, Heath Street, for Boot's, Ltd., chemists, Station Street, Nottingham.
Edmonton.—Workhouse infirmary (£152,640). Steward Hill, 106, Cannon Street, E.C., architect.
(W.).—Reconstruction of 176, Piccadilly, for the Aerated Bread Co., 26, Eastcheap, E.C.
Clapham Park.—Laundry (£1,089). Briet & Son, 99, Kennington Park Road, S.E., surveyors.

LONDON Piccadilly.—Reconstruction of No. 15 for Swan & Edgar, drapers. Love & Co., Exeter Street, Strand, builders.

Chelsea.—Flats in Cheyne Walk. Ross, Branford & Co., 5 and 7, Old Queen Street, Westminster, agents.

Wandsworth.—In last week's notice about the Anglo-American Laundry, the address of the builder was incorrectly given. It should have been W. & C. Brown, Wandsworth Common.

MARLBOROUGH (Wilts.).—New Wesleyan Church and schools. H. W. Irving, Victoria House, Marlborough.

MIDDLESBROUGH.—Extensive works near Newport Ferry. Johnson's Patent Rolling Mills Co., Westminster, London, owners.

MIDDLETON (Lancs.).—New Council School. H. Littler, county architect, Preston.

New cotton mill (92,000 spindles), to be named "The Warwick." Plans in preparation.

MILTON-NEXT-SITTINGBOURNE (Kent.)—Important extensions of paper mills. Edward Lloyd, Ltd., owners, Sittingbourne.

NORTH SHIELDS.—New Wesleyan Church in Coach Lane. Architects, Messrs. Marshall & Tweedy, Newcastle; contractors, Mr. Weir, Howdon-on-Tyne.

OLDHAM.—New cotton mill for the newly registered Mersey Mill Co. Plans in preparation.

PLUMSTEAD.—New Church, St. Michael and all Angels, Abbey Wood Road (£6,050). Sir A. Blomfield & Sons, architects, 6, Montagu Place, Paddington; J. Longley & Co., builders, Crawley, Sussex.

PLYMOUTH.—Installation of the E.L. in the new Workhouse Infirmary, buildings. Thornely & Rooke, architects, The Crescent, Plymouth.

RAWDON (Yorks.)—Co-operative store for Rawdon Industrial Society. W. J. Morley & Son, architects, 269, Swan Arcade, Bradford.

ST. HELENS (Dentons Green).—New Mission Church (£2,700). F. S. Biram, architect, Hardshaw Street, St. Helens; G. Litherland, builder, St. Helens.

SALFORD.—Seedley new baths (£24,000). Architects, Messrs. Mangwall and Littlewood.

SEDGEFIELD (Co. Durham).—Ten houses at the County Asylum. W. Crozier, architect, Shire Hall, Durham.

SHEFFIELD.—Hippodrome (£20,000). Jacob Parkinson & Sons, builders, Kent Road, Blackpool.

SIDCUP (Kent).—Public schools (Longlands, £3,822). C. E. Skinner, builder, Railway Street, Chatham.

STOCKPORT.—Business premises (Park Street). C. Bower & Sons, owners.

SWANSEA.—New hotel, The Cameron (£37,000.) C. T. Ruthin, architect, Bank Chambers, Heathfield Street, Swansea; Henry Billings, builder, Trafalgar Yard, Oystermouth Road, Swansea.

TAUNTON.—Detached residence. F. W. Roberts, architect, 2, Hammet Street, Taunton.

WALLSEND.—Municipal buildings. Liddle & Brown, architects.

WALSALL.—Converting Goodall Street schools into Art schools, including E.L. (£1,020). S. Wootton, builders, Walsall.

WATFORD.—Baptist chapel. Rev. T. Miller Johnson.

WEDNESBURY.—Carnegie library. Crouch, Butler & Savage, architects.

WEST HAM.—Warehouse in Abbey Road for G.E. Railway Co.

Addition to clothing factory. J. R. Moore-Smith, 14, Union Court, Old Broad Street, E.C., architect.

WIGAN (Orrell).—New U.D.C. offices. R., Pennington, architect, Library Street, Wigan; Thos. Massey, builder, Enfield Street, Pemberton, Wigan.

WINDSOR.—Parish Room, Holy Trinity parish (£1,015). S. Wyborn. architect, Windsor; E. Bampfylde, builder, 23, Frances Road, Windsor.

CONTRACTS OPEN and CLOSED.

OPEN.

Adelaide (S.A.).—July 10th. The Postmaster-General requires tenders for 5 miles of insulated copper wire, two switchboards, two lightning arrester boards, 500 No. 2 Leclanché cells, 12 differential galvanometers, 15 electromagnetic transmitters, six plug pattern registering boxes, 500 copper tapes, 5,000 copper binders. Particulars may be obtained at the Commonwealth Offices, 72, Victoria Street, Westminster.

July 31st. The Deputy Postmaster-General at Adelaide is inviting tenders for a considerable quantity of telegraph and telephone apparatus and material, a full list of which appears in the *Board of Trade Journal* for June 6th.

Belgium.—The municipal authorities of Ans, near Liége, are at present inviting tenders for the concession for the private and public electric lighting of the town, and for the supply of electrical energy for power purposes.

Bolton.—The Electricity Committee requires from 10,000 to 15,000 tons of bituminous engine slack, to be delivered in quantities up to 100 tons per day.

Darlington.—Steam and exhaust pipes. See "Official Notices" June 7th.

Eastbourne.—June 29th. Supply and erection of water-tube boiler, steam and water piping, for the T.C. See "Official Notices" June 7th.

Hammersmith.—The Electricity Committee is to obtain tenders for a new motor-generator for use at the King's Theatre. The engineer estimates the cost at £200.

Hampstead.—The electrical engineer has been authorised to obtain motors, house boxes and other stores, at an estimated cost of £317.

Handsworth.—July 10th. Traction and lighting feeders, fibre ducts and road-work. See "Official Notices" to-day.

Hobart (Tasmania).—August 14th. Telegraph and telephone material for the Deputy Postmaster-General. Specifications, &c., at the office of the Australian Commonwealth, 72, Victoria Street, S.W.

July 29th. Telephone subscriber service meters, racks, and cable for the Deputy Postmaster-General at Hobart. General and special conditions, &c., can be seen at the General Post Offices at Hobart, Sydney, Melbourne, Brisbane, Adelaide and Perth.

L.C.C.—July 9th. Two 5,000-kw. three-phase steam turbo-generators with surface condensers, &c., for East Greenwich tramways generating station. See "Official Notices" June 14th.

L.C.C.—July 16th. 78 tramway feeder pillars and overhead equipment for Woolwich double track. See "Official Notices" to-day.

London.—July 9th. Installation of electric light, bells, telephones and motors for the L.C.C. See "Official Notices" June 21st.

Manchester.—Steam piping, superheaters, steam traps, &c., for Messrs. John Collier & Co. See "Official Notices" June 21st.

Newport (Mon.).—July 1st. Switchboard, motor alternators, battery, cooling tower, reversible booster, &c., for the Corporation. See "Official Notices" June 14th.

Perth (W.A.).—August 6th. Desiccating apparatus with motor-driven air-pump for telephone cable work for the Deputy Postmaster-General. Specifications at the Commonwealth Office, 72, Victoria Street, S.W.

Pontypridd.—July 8th. To supply and lay 3,000 yards of triple-concentric paper-insulated cables. See "Official Notices" June 21st.

Rotherham.—July 12th. Cable and meters for one year for the E.L. department. See "Official Notices" to-day.

Roumania.—The Roumanian military authorities in Bucharest are about to invite tenders for the supply of seven steam engines and dynamos, required in connection with the electric lighting plant which is being installed at the Military Bakeries in Bucharest.

Spain.—August 12th. The Spanish Ministry of Public Works in Madrid is inviting tenders until August 12th for the concession for the construction and working of an electric tramway in the town of Valencia.

Spain.—Tenders have been invited by the municipal authorities of Salvatierra de los Barros (province of Badajoz) for the concession for the electric lighting of the town.

Stepney.—July 1st. Meters, demand indicators and arc lamp carbons for the Electricity Committee. See "Official Notices" June 14th.

Sydney (N.S.W.).—August 14th. The Deputy Postmaster-General is inviting tenders for telegraph, telephone and electric light material.

Victoria.—July 16th. The Deputy Postmaster-General requires tenders for cable, switchboards, telephones, and various telephone and telegraph apparatus. Detailed specifications may be seen at the office of the officer representing the Commonwealth of Australia in London, Captain Collins, C.M.G., 72, Victoria Street, Westminster, S.W.

Warrington.—July 16th. Erection of buildings for boiler plant extension for the electricity department. See "Official Notices" to-day.

CLOSED.

Barnes.—The U.D.C. has accepted the tender of Messrs. Spencer, Santo & Co., at £1,300, for an extension to the electricity works at Mortlake.

Belgium.—Ten firms submitted tenders for the supply of the electric cables required in connection with the new Nord docks at Antwerp, the lowest being that of Messrs. Felten and Guilleaume, Lahmeyerwerke, Mülheim-am-Rhine, Germany, who quoted £4,347. The British firm, the British Insulated & Helsby Cables, Ltd., of Prescot, asked £4,990.

Cambuslang.—The following is a list of tenders submitted to the Lanark County Council for Sections A, B, C (motor-generator, alternating and direct-current switchboards, battery booster, cables, &c.), for the Cambuslang electricity works extensions:—

British Westinghouse Co. ..	£804	Lancashire Dynamo Co. ..	£981
Johnson & Phillips (accepted)	812	J. Ferguson	986
Cox-Walkers	846	Newtons, Ltd. (Taunton) ..	989
General Electric Co.	907	Siemens	1,004
Johnston, Park & Co.	918	Brush Elec. Engineering Co. ..	1,083
Fyfe Wilson	929	Electric Construction Co. ..	1,126
British Electric Plant Co. ..	930	Union Electric Co.	1,139
Crompton & Co.	932	Santoni & Co.	1,197
Phœnix Dynamo Co.	967		

For Section D (battery) the following estimates were sent in:—

Chloride Electrical Storage Co.	£450	E.P.S. Co. .. .. (accepted)	£535
Cox-Walkers	450	Hagen	565
Premier Accumulator Co. ..	460	Hart Accumulator Co.	598
Tudor Accumulator Co. ..	497	British Accumulator Co. ..	625
D.P. Battery Co.	500	Fyfe Wilson	642
Haunz	523	Johnston, Park & Co.	651

East Ham.—The T.C. has accepted the following tenders:—

Two additional cooling towers.—Klein Engineering Co., £896.
Feeder cable.—Callender's Cable & Construction Co., £396.

Falkirk.—Alexander Stores, Ltd., have received the contract for wrought-iron tubing for the electric works, and the offer of the Callender's Cable Co. has been accepted for cable; Crompton & Co., Ltd., are to supply electrically-driven capstans for the gas works.

Hammersmith.—The B.C. has placed an order with the British Electric Transformer Co., Ltd., at £336, for a 300-KW. transformer and a set of series gear.

The electricity department has accepted an offer from the Crynant Colliery Co., Ltd., to supply the Council with 1,000 tons of coal under the terms of their previous contract, viz., 12s. 10d. per ton delivered alongside, provided the Council will purchase a further 1,000 tons at the current price of 16s. 10d. per ton delivered alongside.

Leeds.—Messrs. T. Harding Churton & Co. have received, per Messrs. Ferranti, Ltd., an order for two motor-generators for the City Council.

Leyton.—The U.D.C. received seven tenders for the annual supply of coal to the generating station, and accepted the following:—Wm. Cory & Son, Ltd., 4,000 tons hand-picked Linby small hard steam coal, 17s. 10d. per ton; 5,000 tons hand-picked Newstead small hard steam coal, 17s. 10d. per ton. The Council is to have the option to take any more coal which may be required as follows:—Linby 18s. 1d., Newstead 18s. 1d., or hand-picked Annesley small hard steam coal 17s. 10d.

London.—ST. PANCRAS.—The B.C. has accepted the tender of Spencer, Santo & Co., Ltd. (£3,825) for the buildings for the King's Road generating station. The tender of E. C. and J. Keay was accepted for the constructional steel-work in connection with the buildings, at £1,624; and that of Adamson, Ramsbottom and Co., Ltd., was accepted for an overhead travelling crane, at £640, for use in the extension. 22 tenders were received for the supply of coal to the Regent's Park and King's Road power stations for the 12 months from July 1st next, and the following were accepted:—

Brentnall & Cleland.—Barber Walker's nutty slack (about 5,600 tons), to be delivered at the King's Road works, at 13s. 7d. per ton; Warwickshire small nuts (about 5,000 tons), to be delivered at the King's Road works, at 15s. 10d. per ton; and Watnall seconds hard steam (about 6,616 tons), to be delivered at the Regent's Park works, at 16s. 9d. per ton, and at the King's Road works, at 16s. 7d. per ton.
G. Hinchliffe & Co.—Welsh (Bwllfa) coal, to be delivered at the Regent's Park and King's Road works, at 23s. 11d. per ton.

L.C.C.—The Highways Committee of the L.C.C. have received the following tenders for the supply of about 95 miles of low-tension cable:—

Western Electric Co. ..	(recommended)	£55,201
W. T. Henley's Telegraph Works		56,357
Union Cable Co.		56,397
Johnson & Phillips		56,574
Siemens Bros. & Co.		56,645
Callender's Cable Co.		56,666
British Insulated & Helsby Cables		57,268
W. T. Glover & Co.		59,469
St. Helens Cable & Rubber Co.		60,750

The tenderers were asked to submit rates of change of price of cable a mile, to be added to or deducted from their tenders, according to the actual price of copper when the orders for the several lengths of cable are given. The tender recommended for acceptance is put forward on this basis, the County Council being at liberty to omit up to 20 per cent. of the work if considered necessary.

MARYLEBONE.—The B.C. has accepted the tender of the E.P.S. Co., at £1,170, for repairs to the old North Street battery.

Mansfield.—The T.C. has accepted the tender of the Western Electric Co. for the supply of tramway feeder.

Peterborough.—The T.C. has accepted the tender of the General Post Office for a water level indicator and telephone between the City, Etton and Braceborough, at £84 5s. per annum. The Great Northern Railway Co. tendered at £89 12s. per annum.

Portsmouth.—The T.C. has accepted the tender of Messrs. Baker & Co., of Rotherham, for the supply of 200 new tramway tires, at 31s. 6d. each.

Wallasey.—Messrs. Pope's Electric Lamp Co. have secured the contracts from the U.D.C. for the supply of "Pope" lamps for 12 months.

West Ham.—The T.C. has placed an order with the Fuller Electrical Co. for a rotary converter of a larger size than that previously ordered, and to cost £310, an increase of £25 on the original cost. The Council has made special arrangements with the General Electric Co. for the supply of 800 Osram lamps per month for 12 months, terms being arranged as to the return of faulty lamps and for an increased discount.

Wolverhampton.—Messrs. Bruce Peebles & Co., Ltd., have received from the Corporation an order for a 500-KW. 50-cycle motor-converter.

Wrexham.—The tender of Messrs. Heaney & Co., of Borough Road, Birkenhead, has been accepted for the electric light installation at the new Post and Inland Revenue Offices at Wrexham.

FORTHCOMING EVENTS.

Friday, June 28th.—At 5 p.m. Physical Society of London. Meeting at the City and Guilds' Central Technical College, Exhibition Road, S.W. Agenda: Mr. J. T. Irwin—Demonstration of the uses of his hot-wire oscillographs and hot-wire wattmeters. Mr. J. S. Dow—A cosine flicker photometer, and some phenomena in colour vision. Prof. W. E. Ayrton and Mr. T. Mather—Description and exhibition of students' apparatus for measuring permeability and hysteresis; and design of chokers.

Saturday, June 29th, to July 6th.—Junior Institution of Engineers. Summer meeting in the Clyde District.

Tuesday, July 9th.—Conversazione of the Society of Arts.

NOTES.

Will.—The late Sir Benjamin Baker left estate valued at £170,513 gross, and net personalty sworn at £166,634.

Opening of the Hampstead Tube Railway.—The Charing Cross, Euston and Hampstead new tube railway was opened on Saturday last by the President of the Board of Trade, who started the first train from Charing Cross with a silver-gilt key. Golder's Green car depôt served as a luncheon pavilion, at which Sir E. Speyer, chairman of the Underground Electric Railways Co., presided. Sir Geo. Gibb said that the line completed the undertaking planned by Mr. Yerkes. Arrangements had been practically concluded with the Central London for through fares. Sir E. Speyer, in the course of his speech, said that to help forward the work of providing London with the most economical and efficient system of transport, they would be prepared to consider any suggestion whereby the municipality would acquire an interest in these tubes. In other words, they would be prepared to grant to the municipality the right of purchasing these tubes at dates to be agreed upon at a reasonable price, in consideration of the municipality providing a portion of the capital expended for their construction, or, as an alternative, lending its credit for the purpose of raising the capital expended upon the construction of the tubes at a reasonable rate of interest.

Mr. Lloyd-George congratulated the promoters and builders of the tubes. He said that Col. Yorke spoke in the very highest terms about the Hampstead Railway, both from the engineering point of view and as to the comfort and security of the public. Last year the underground railways run by electric traction carried more than 240 million passengers. It was only within a comparatively few years that the great tube railways had started. He could only think in amazement on what would have happened in London if these tubes had not been available. The streets were congested enough even now. But the tubes had done more than bring relief to the traffic. He believed they had done more to assist in solving the housing problem than the most skilfully devised Act of Parliament could do. Some surprise had been expressed that the recommendations of the Traffic Commission had not been carried out. The Government, he said, were considering the report with a view to action—probably immediate action. They were fully alive to the importance and urgency of co-ordinating the means of communication in London. Speaking of the increase of fares generally, he did not think it was in the interest of the public that great interests of this kind should be run at a loss. It was much better that fares should be so adjusted as to give adequate return to honest investors in legitimate enterprises. There had been expressed fears of socialistic and revolutionary legislation. So far as he knew they were unfounded. Governments never realised the best hopes of their friends or the worst fears of their enemies. He could not think of any measures which the Government had in mind that ought to give a moment's anxiety to any honest investor looking forward to getting a reasonable return for money put into legitimate enterprises.

The directors had hit upon the excellent idea of throwing the line open for free traffic on the opening day in order to advertise the new facilities. Some 127,000 passengers were carried.

Milan International Exhibition, 1906.—In the report of the British Commission of the Milan International Exhibition, 1906, to Sir Edward Grey, Secretary of State for Foreign Affairs, Mr. Arthur Serena, hon. executive Commissioner, says: "The British record is highly satisfactory. The exhibitors formed only 2·63 per cent. of the total, but they carried away 3·34 per cent. of the awards. The proportion of the awards throughout the exhibition was 0·81, France and Belgium obtaining respectively 0·69 and 0·74, and Great Britain 1·06; Germany alone obtained a higher figure (1·33). The results, in the case of Great Britain, at least, were certainly not due to a preponderance of seats on the juries, as there were only 41 out of 1,317, or 3·11 per cent., whilst Germany had 107 out of the same total, or 8·12 per cent.—a much heavier proportion. It would appear, however, that the success attained by Germany was chiefly due to the adoption, by their Commission, of a special attitude towards the International Jury which constituted a distinct, but, as it proved, a profitable innovation. They drew up lists of awards that each jury should, in the opinion of the Commission, bestow upon the exhibitors. These lists were circulated by the German representatives to the various juries, and the awards thus suggested were in the majority of cases bestowed."

Unprofitable Motor-buses.—It is reported that the new motor-'bus service established by the Corporation between Bolton and the village of Darcy Lever is proving unremunerative so far. Big losses are being sustained by the Todmorden Corporation on their motor-'buses.

Electric Shock Fatalities.—The *Morning Advertiser* reports that an inquiry has just been held at Birmingham concerning the death of Herbert E. Fisher, machine traveller, employed by the Metropolitan Amalgamated Railway Carriage and Wagon Co. Deceased was coupling up some pneumatic tubes, when he accidentally touched the frame of an electric lamp with a bar of iron which he had in his hand, and received a shock at about 1,000 volts. Death occurred instantly. No blame was attached to anyone, and the jury returned a verdict of "Accidental death."

According to the New York correspondent of the *Daily Telegraph*, while seven men were wheeling a large portable steam boiler on a trolley car at Staten Island, four of them were instantaneously killed by electric shock. It appears that the top of the boiler came into contact with the overhead wires (14 ft. above ground), while crossing the track at right angles. It is said that the pressure was 15,000 volts. The men were in a hurry to knock off work, and did not notice that there was not room for the trolley with the boiler, the top of which was 17 ft. from the ground, to pass underneath the wires.

Electric Cabs in Berlin.—The experience of the Berlin Elektromobil Droschken Gesellschaft, which was formed in 1905, and which completed its first complete working year in 1906, has so far not been very satisfactory, and the reasons adduced for this state of affairs are not without interest. According to the directors' report, the course of business in 1906 was affected by a series of unfortunate contingencies. In the first place, the batteries left much to be desired, although this obstacle was eventually overcome on the opening of the second depôt at Halensee. Secondly, the rubber tires of the cabs, contrary to technical expectations, caused the company special difficulties. The defects became of unusual extent, especially under the influence of the heat. A third matter which affected the year's trading was a strike of the cab drivers, who claimed a proportionate share of the increase in the basis or initial taxameter fare which was sanctioned by the police authorities. This fact placed a burden upon the driving school which the company is compelled to maintain, as there were no trained drivers to be had, or at all events such drivers who possessed the knowledge of localities required by the police authorities. The accounts for 1906, including the slight balance brought forward from the previous year, show total receipts amounting to £45,486, as compared with £2,328 in 1905. After meeting working expenses and providing £8,124 for depreciation, and absorbing the reserve fund of £7,509, there remains a loss of £3,170 to be carried forward. As to the future prospects, the directors of the company state that the working of the cabs hitherto has undoubtedly shown that the undertaking is an opportune one, and that it will be a remunerative enterprise as carried out by the company on a large scale. The cabs are in constant demand, and the receipts per car-mile are increasing and correspond to the calculations upon which the undertaking was founded.

The Mercury Vapour Quartz Lamp.—The subject of mercury vapour lamps was discussed by Herr O. Bussmann at a recent meeting of the Electro-technical Association in Berlin. After referring to the unwieldiness of mercury vapour lamps with long glass tubes, the author stated that Dr. Richard Küch had devised such a lamp with a tube made of quartz. At a pressure of 110 volts these lamps only require a lighting tube length of 3½ in., as compared with 3 ft. 4 in. in the case of ordinary glass tubes. Instead of giving forth a greenish-blue light, the quartz lamp yields a far more pleasant yellowish-white light and has an extremely small consumption of energy. It is claimed that the consumption can be reduced to one-sixth of a watt per candle-power, whereas in the case of the earlier mercury vapour lamps, in which the illuminating power did not increase in the same degree as the supply of energy, the specific consumption of energy advanced to from 1 watt to 1·2 watt per candle-power. It is stated that the present method of constructing the quartz lamps renders them specially suitable for the lighting of railway stations and streets, as the non-necessity for attention represents a considerable saving in time, and the lamps are also adapted for the illumination of workshops, offices, &c., where a differentiation of colours is not required. The richness of the lamp in ultra-violet rays is said to cause it to be applicable for use in the therapeutic treatment of diseases, especially skin diseases. Experiments are in preparation for the application of the rays to the sterilisation of liquids, and the insensitiveness of quartz to changes in temperature is said to allow of the production of a submarine lamp of large lighting powers.

Institution and Lecture Notes.—JUNIOR INSTITUTION OF ENGINEERS.—During the meeting of this Institution in the Clyde district next week (July 1st to 5th), the following works will be visited:—Messrs. Barr & Stroud's Works, Caxton Street, near Anniesland; Messrs. Sir William Arrol & Co., Ltd.; Corporation Sewage Works; Messrs. Stewarts & Lloyds' Tube Works, Rutherglen; Farne Colliery, and inspect Newcomen engine; North British Locomotive Company, Ltd.; Elevating Ferry at Stobcross; Cattle lairage, Horklands Quay; Rothesay Dock Works, Electric Station, and Coal Hoists; Clyde Trust Works, Renfrew Wharf; Naval Construction Works of Messrs. Beardmore & Co., Ltd.; Corporation Sewage Works at Dalmuir; Dock and Ore-handling plant and Pumping Station at Queen's Dock; Fairfield Shipbuilding and Engineering Co.; Messrs. Babcock & Wilcox's Works; Engineering Laboratory, Edinburgh University; Forth Bridge; Sewing Machine Works of Messrs. Singers; Messrs. John Brown and Co., Ltd.; Lanarkshire Steel Works; Messrs. Yarrow & Co. On the Monday the members are to be received and entertained at luncheon by the Lord Provost and Magistrates of Glasgow. The summer dinner is to be held at the Windsor Hotel on Friday, July 5th.

ROYAL SOCIETY.—Among the papers to be read yesterday afternoon were:—

A. Campbell.—"On a Standard of Mutual Induction." Communicated by Dr. Glazebrook, F.R.S.

Prof. W. E. Ayrton, F.R.S., T. Mather, F.R.S., and F. E. Smith.—"A New Current Weigher and a Determination of the E.M.F. of the Normal Weston Cadmium Cell."

P. D. Innes.—"On the Velocity of the Cathode Particles emitted by various Metals under the Influence of Röntgen Rays and its Bearing on the Theory of Atomic Disintegration." Communicated by Prof. J. J. Thomson, F.R.S.

G. F. C. Searle, F.R.S.—"On the Force required to stop a Moving Electrified Sphere."

Hon. C. A. Parsons, C.B., F.R.S.—"Some Notes on Carbon at High Temperatures and Pressures."

Appointment Vacant.—Shift engineer for the Dewsbury electricity department (35s.).

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The directors, staff and employés of the North of Scotland Electric Light & Power Co., Ltd., on Monday evening last at the Central Hotel, Montrose, presented Mr. HAROLD HALE, manager and secretary to the company (who is leaving to take up the position of chief engineer to the Savoy Hotel, Ltd., London), with a silver rose-bowl and a silver cigarette case. The presentation was followed by a musical programme.

Mr. E. WATSON LUNDIE NICOL is proposed by the Highways Committee of the L.C.C. as a charge engineer at the Greenwich generating station at a salary of £250 per annum. This appointment will increase the number of charge engineers to four, although one has been temporarily engaged on steamboat work for some time past.

Mr. A. C. HANSON, after consultation with a specialist, has resigned his position as burgh electrical engineer at Stirling through ill-health, his only chance of recovery being long and complete rest. Mr. Hanson has been connected with the system for 7½ years. The T.C. has forwarded an expression of its sympathy and regret, and the Lighting Committee has been authorised to take whatever steps it may see fit.

At Dundee electricity station Mr. CHARLES LAMB, distribution engineer of the department, was, on the occasion of his marriage, made the recipient of a marble timepiece, together with a gold brooch for his bride-elect. The presentation was made by Mr. Harry Richardson, the city electrical engineer.

The Bolton Tramways Committee has resolved that the salary of Mr. A. A. DAY, borough electrical engineer and tramways manager, shall be advanced £50 per annum, such sum to be apportioned between the Tramways Committee and the Electricity Committee in such amounts as may be agreed upon.

Mr. G. H. SAUNDERS, of Dewsbury electricity works, has been appointed charge engineer at the Acton U.D.C. electricity works, and Mr. H. D. CROMBIE, of Reading electricity works, has been appointed canvasser at Acton.

Mr. F. J. Masters has resigned his position as station superintendent at Canning Town generating station (West Ham). The West Ham Town Council has appointed Mr. G. Lloyd-Jones, late of the South London Electric Supply Corporation, to fill the vacancy thus caused at £260 per annum.

The staff and friends of the Govan electricity department went for their first annual outing recently, the day being spent at Whistlefield, Loch Long.

Mr. W. G. Pickrance, chief assistant engineer, at Malvern electricity works, has been appointed electrical engineer to the Borough of Wrexham, and will take up his duties in about a month.

Tramway Officials.—The employés of the Barnsley and District Electric Traction Co., Ltd., have presented the manager, Mr. W. H. Moorhouse, with an oak roll-top desk on his departure to take up the position of resident manager to the Llandudno and Colwyn Bay Light Railway and Construction Co. Mrs. Moorhouse was presented with an oak bookcase.

General.—Mr. Charles Bright, F.R.S.E., M.I.E.E., has removed his office from 21, Old Queen Street, Westminster, to Parliament Chambers, Westminster.

Mr. Geo. Morrison, of the firm of Morrison & Roebuck, electrical engineers, Birley Street, Blackpool, was married on June 19th to Miss Fanny Oddy, of South Shore.

Mr. A. Murray Coombs, A.M.I.E.E., has resigned his appointment with the "D.P." Battery Co., Ltd., of 11, Victoria Street, S.W., and is now a director of the firm of Frank Suter & Co., Ltd.

Mr. W. Noble, first-class staff engineer in the engineer-in-chief's office, Post Office Telegraphs, has been appointed superintending engineer of the metropolitan central district.

Mr. Robert Anderson, inspector at Blackburn for the National Telephone Co., has been presented, on his marriage, with a case of carvers, silver jam spoon, pickle fork and butter knife by the electrical staff, and with a dinner service by the telephone staff.

The Emperor of Austria has appointed Mr. Henry Goiginger Director-General of Posts and Telegraphs.

The directors of the County of London Electric Supply Co., Ltd., have appointed Mr. H. B. Renwick (at present secretary) general manager and secretary to the company, and Mr. C. P. Sparks (at present chief engineer) engineer-in-chief to the company.

The *Times* says that the following appointments have been made at Guy's Hospital:—Dr. Hertz, physician to the electrical department; Mr. Iredell, surgeon to the actino-therapeutic department; Dr. Jordan, medical radiographer; and Dr. C. J. Morton, surgical radiographer.

Obituary.—Perry F. Nursey.—We regret to record the death of Mr. Perry Fairfax Nursey at the age of 76 years. For very many years—practically from its beginning, nearly fifty years ago—he had been a most prominent member of the Society of Engineers, of which he had been for a long period secretary, and had also occupied the offices of president and treasurer, before which he had read a large number of papers on a great variety of subjects. He will be rememembered by some of our readers as a contributor to the *Times* on engineering matters.

Bartholomew Cabella.—We learn with regret of the death of Mr. Bartholomew Cabella, Studio di Elettrotecnica e Ingegneria Industriale, Milan.

J. H. Bower.—The death occurred on June 20th, as the result of an accident, of Mr. John Herbert Bower, member of the firm of Alvey and Bower, electricians, Packers Row, Chesterfield. Deceased, who was 46 years of age, fell a distance of 16 ft. whilst fixing electric lights, and sustained a fractured skull and a compound fracture of the left elbow.

NEW COMPANIES REGISTERED.

Rothwell's Patents Syndicate, Ltd. (93,634).—This company was registered on June 6th, with a capital of £2,000 in £5 shares, to acquire from E. Rothwell the benefit of certain existing inventions relating to improvements connected with electric railways working on the third rail or surface-contact system, and to carry on the business of founders, electrical and general engineers, dealers in wires, cables and lines, suppliers of electric light, heat and motive power, manufacturers of electrical apparatus, &c. The first subscribers (each with one share) are:—G. W. Ross, 17, Stanley Street, Bury, hotel proprietor; O. O. Rothwell, 71, Great Cheetham Street, West Broughton, Manchester, printer; J. Stone, 24, Rock Street, Bury, pork butcher; B. C. Law, 15, Rock Street, Bury, hairdresser; J. C. Hearne, 51, Walmersley Road, Bury, engineer, &c.; S. B. Ambler, 27, Bolton Street, Bury, outfitter, &c.; and G. M. Gibson, Elton Fold Works, Bury, engineer. No initial public issue. The number of directors is not to be less than two or more than eleven; the first are B. C. Law, J. Stone, S. B. Ambler, M. B. Mountain, G. M. Gibson, J. C. Hearne, G. Ross, R. Jackson, J. E. Muir, and O. O. Rothwell. Qualification, £50 shares or stock.

Cooper & Clegg, Ltd. (93,658).—This company was registered on June 8th, with a capital of £2,000 in £1 shares, to acquire the business carried on at 34, Pall Mall, Manchester, as "Cooper & Clegg," and to carry on the business of electricians, electric light and power and mechanical engineers, manufacturers of, and dealers in, motor-cars and wagons, makers of electrical apparatus, &c. The first subscribers (each with one share) are:—J. F. Cooper, Ellerslie, Withington, Manchester, calico printer; Mrs. A. A. Cooper, Ellerslie, Withington, Manchester; J. K. Cooper, Ellerslie, Withington, Manchester, electrical engineer; H. H. Clegg, Penralt, Prestwich, Manchester, electrical engineer; H. W. Clegg, Ash Lea, Prestwich, Manchester, gentleman; Mrs. M. Clegg, Ash Lea, Prestwich, Manchester; and Mrs. E. E. Clegg, Penralt, Prestwich, Manchester. No initial public issue. The number of directors is not to be less than two or more than four; the first are J. K. Cooper and H. H. Clegg; remuneration as fixed by the company. Registered office, 34, Pall Mall, Manchester.

Tramways Supplies, Ltd. (93,698).—This company was registered on June 11th, with a capital of £10,000 in £1 shares, to adopt an agreement between S. Dixon & Son, Ltd., of the first part, W. H. Turner of the second part, and H. Lawton of the third part, and to carry on the business of manufacturers of, agents for and dealers in electric tramway materials, tram-car trucks, motor equipments, car fittings and all tramway specialities and requisites, &c. The first subscribers (each with one share) are: R. E. Dixon, Swinegate, Leeds, engineer; C. Dixon, Swinegate, Leeds, brassfounder; H. C. Walker, Swinegate, Leeds, brassfounders; W. H. Turner, 575, Meanwood Road, Leeds, electrical engineer; H. Jennings, 28, Hillidge Road, Leeds, clerk; H. Lawton, 24, Clifton Terrace, Leeds, clerk; and C. C. Milligan, 19, Springfield Mount, Leeds, clerk. No initial public issue. The number of directors is not to be less than three, or more than seven; W. H. Turner is the first managing director. S. Dixon & Son, Ltd., may appoint two directors, one of whom shall be chairman; other directors to be appointed by the subscribers; qualification (except first directors), £100; remuneration as fixed by the company. Registered office, 31, Swinegate, Leeds.

Hankow Engineering Development Syndicate, Ltd. (93,676).—This company was registered on June 10th, with a capital of £1,000 in 5s. shares, to acquire and develop property and rights of all kinds, and to carry on the business of electrical and mechanical engineers and contractors, suppliers of electricity, dealers in railway, tramway, waterworks and other apparatus, &c. The first subscribers (each with one share) are:—P. Garratt, Lincoln Chambers, Lincoln's Inn Fields, W.C., chartered accountant; J. A. Atherton, 15, Abchurch Lane, E.C., solicitor; A. Lewis, 15, Abchurch Lane, E.C., clerk; C. J. Kohler, 15, Abchurch Lane, E.C., architect; O. L. Richardson, 1, Roseleigh Avenue, Highbury, N., clerk; H. L. Stafford, 8, Chestnut Road, Kingston, law student; and S. Wright, 223, Albert Road, Addiscombe, Surrey, clerk. No initial public issue. Registered without articles of association.

CITY NOTES.

The Globe Telegraph and Trust Co.

The meeting of this company was held on Tuesday, at Electra House, the Marquis of Tweeddale presiding.

The Chairman pointed out that the report and accounts covered 13 months, instead of the usual 12 months. By including the month of May in the report, a difference of £34,000 in their accounts was made. If they had not included that month, they would only have been enabled to pay a final dividend of 2s. 3d. per share, which together with the interim dividends made 4½ per cent., instead of the dividend they were now declaring 5s. 6d., or 5¾ per cent.—that was an addition of 1s. 6d. for the extra month's working. The net result of the 13 months' working, after deducting expenses, amounted to £244,096, which together with the balance brought forward from last year, £4,499, made a total of £248,596. From that amount they had to deduct £131,769 paid in interim dividends which left an available balance of £116,827. The board proposed to deal with that money by the payment of a final dividend, which, on this occasion, covered a period of four months to May 31st, of 4s. per share, less income-tax, on the preference shares, making with previous distributions a total dividend on those shares at the rate of 6 per cent. per annum, less income-tax, for the period of 13 months, and 6s. 2d. per share on the ordinary shares, making with previous distributions a dividend of 5¾ per cent, as against 5½ per cent. last year. That was the largest dividend during the company's 34 years of existence. To the 5¾ per cent. they had to add 8d. per share in respect of the month of May, representing one-third of the interim dividend of 2s. usually paid in the first quarter of the year. The payment of those dividends would absorb £90,261, leaving a balance of £26,565 to be carried forward. The carry-over was rather large, owing to their receiving some dividends which really belonged to the current year. There was no change in the capital investments of the company. They had in some instances received increased dividends, while in others they had decreased. A particular company that had paid an increased dividend was the Direct United States Cable Co., which formerly paid 3⅜ per cent., but which this year paid 4⅜ per cent., a difference of £1,987 to the company. Taking all the investments as they stood, there was a surplus over costs of considerably more than £400,000.

Sir James Pender, Bart., seconded the motion, and the report was adopted.

Electricity Supply Co. for Spain, Ltd.

The directors' report for 1906 shows that the company's revenue of Ptas. 1,100,000 has this year produced £37,830, an improvement of £4,922 over the year 1905, and no less than £5,777 over the average of the five previous years; a favourable result, due entirely to the rise in the value of the peseta, on which the shareholders are to be congratulated. Should the exchange remain steady, the income for 1907 will show even better figures. Including interest on deposits and other receipts, the gross revenue for the year amounted to £38,533. After deducting debenture interest, interest on loans, income-tax and all other charges, amounting to £18,730 19s. 8d., there remains a net sum of £19,802. Of this, £15,247 has been applied to the redemption of debentures, leaving a net profit for the year of £4,555, which, with £7,479 brought forward from last year, makes a balance to the credit of profit and loss of £12,034, which the directors propose to carry forward. Of the sum of £15,247 devoted to the redemption of debentures, £2,247 constitutes the sinking fund of the consolidated debentures. The £13,000 used for redeeming the first and "B" mortgage debentures need not have been provided out of revenue, but the shareholders have once more consented to forego their right to a dividend, and have again approved the policy of the directors in strengthening the

position of the company by paying off the debenture debt as rapidly as possible. The debt due to the Compania General Madrilena de Electricidad has been reduced during the year from Ptas. 850,591.49 to Ptas. 749,018.91, but, being converted at Ptas. 27.44 = £1, instead of at 31.70 as in 1905, the sterling equivalent has increased from £26,833 to £27,297. There has, therefore, been a loss in exchange on this account of £3,960. This has in some measure counterbalanced the increase in the revenue, but this debt having now been written down to 27.44, a similar loss will not occur again, whilst, given a steady exchange, the improvement in the revenue will be a permanent one. Debentures amounting to £15,300 have been paid off during the year. The amount falling due in 1907 is £16,300. The directors announce the death, in July last year, of their colleague Mr. Samuel Kocherthaler. They have appointed Mr. Oskar Oliven, managing director of the Gesellschaft für Elektrische Unternehmungen, of Berlin, to fill the vacancy.

Indian Electric Supply and Traction Co., Ltd.

The directors' report to December 31st, 1906, presented at the annual meeting held on Tuesday at Winchester House, said that the work of construction at that date was still proceeding, and it was not until April 25th, 1907, that the buildings and the greater part of the plant, tramways, &c., were taken over by the company from the contractors, under the supervising engineers' certificates. The supply of current for the lighting and fan business was commenced on a small scale on January 1st, 1907, and some 2,000 8-c.p. lamps are already connected to the mains. The local agents anticipate a large demand from the natives, and in order to serve them an extension of the mains into the thickly-populated native quarters of the city will be called for. The municipal authorities have arranged to take a supply of current from the company for the lighting of the roads through which the tramway is laid, at 3 annas per unit under the terms provided in the licence. The greater portion of the tramway system was opened for public service on March 11th, and is working satisfactorily, and a very fair traffic has already been secured. Probably it will be found desirable to extend the system, which at present is only 3½ miles, so as more fully to meet the requirements of the city. Sir Walter Lawrence, owing to the pressure of his engagements, has found it necessary to relinquish the chairmanship, but the company will still have the benent of his wide Indian experience, as he retains a seat on the board. Mr. John G. B. Stone has been elected chairman in his place.

Mr. J. G. B. Stone presided over the meeting, and he said that inadvertently the name Cawnpore was omitted from the report, but he thought most of the stockholders appreciated that that was the only town in which they were at present at work. At the time the accounts were made up, the work of construction was still proceeding. They would probably recollect that at the last meeting they hoped the works would have been taken over and supply commenced before the end of the year. Unfortunately there had been delays which had prevented this, and he thought the plague, which was so severe in many part of India, including Cawnpore, contributed materially to that delay by interfering with the supply of labour. The supply of electricity for lighting and fans was commenced in January of this year. It was rather early as yet to say much with regard to the immediate future, but he thought they might regard it as promising. Although in the report they mentioned only 2,000 lamps as connected, and the initial contract with the municipality, they had very encouraging advices from their agents. They had secured a contract with one of the important mills for a supply for lighting and fans for a period of five years for a minimum amount of 100,000 units per annum. Another large mill in Cawnpore was taking current for part of its lighting and fan load, and was experimenting in one of its minor departments with the company's supply for the electrical driving of its machinery. They hoped that those would lead to bigger contracts and to a demand from other quarters of a similar character, in addition to the general demand from private consumers in the compulsory area in which the mains were laid. Outside that area their agents had made a careful canvass of the more thickly populated native centres with very encouraging results. With regard to the tramway, a very fair traffic was being already secured, in spite of the efforts of the drivers of the ekkas, who had reduced their charges some 40 per cent. in their endeavours to retain this traffic. The Board were advised that extensions would be called for to meet the requirements of the population. Both those matters were being carefully gone into, and before they met again next year he thought they would bring before them a scheme embracing the extension of both the lighting and tramway systems. Negotiations were proceeding with the Cantonment authorities for a supply, and they hoped to secure a contract there before very long. With regard to other Government departments, they regretted to say that although they had met with ample expressions of goodwill, practical support in the form of contracts had not been forthcoming. That lack of encouragement checked the introduction of electric supply in other cities of India where the commercial element was less predominant than it was in Cawnpore, and in that connection he might say the board had had the question of supply in some other towns brought before them, but had not thought their prospects sufficiently assured to ask them to embark capital.

Sir Walter R. Lawrence seconded the motion.

Mr. Pickford (a representative of the company's agents in Cawnpore) gave an explanation as to the position of the company's workings, and said that negotiations were in progress with possible consumers, but those matters, more especially in the case of native consumers, of course, took time. The negotiations with one important concern had been brought to a successful conclusion, and they had good reason to hope that a contract for the supply of energy for lighting and fans to the barracks and other military buildings would be given to the company. There was every prospect, also, of the new Currency Offices and other buildings under the control of the Local Government being installed with lights and fans, and, in fact, that might, ere now, have been decided on. He could not enter further into particulars on that subject now, beyond assuring shareholders that they in Cawnpore were fully alive to the paramount importance of bringing the load up to the full capacity of the company's plant within the shortest possible period, and as the advantages of electrical driving were fairly widely appreciated in Cawnpore, they felt very hopeful that this consummation would not be unduly delayed. The company's cars were now plying in the streets of Cawnpore. A feeling of considerable anxiety was inseparable from an undertaking of this nature, Cawnpore being, as they were no doubt aware, the first provincial city in India in which a public supply of electricity had been made available. In Bombay, Calcutta, Madras and Rangoon natives had already been educated to the use and advantage of tramcars, and the substitution of electric for horse traction was unlikely to create any feeling other than a sense of satisfaction at the increased speed and comfort obtained. In Cawnpore the native was less accustomed to Western institutions, and it had, therefore, been a great relief to them that no objection emanating from caste or religious prejudice has made itself manifest. They had, therefore, to deal with recognised and anticipated problems of competition. In that matter, also, conditions in Cawnpore differed from those obtaining in the Presidency towns, since the ekka—a vehicle used by the section of the public on whom they depended to a great extent for their traffic—was unknown in the provincial capitals. For the benefit of those who has not visited the provinces of India, he would explain that ekkas consisted merely of a light platform mounted on two wheels, and they were drawn by small country-bred ponies. The initial outlay on those vehicles was small, and the cost of upkeep trifling, and fares were, therefore, charged on a very moderate scale. The company's fares were now being adapted to meet that—the only serious form of competition they had to face—and they felt confident that the advantages of travelling on the company's cars would become rapidly and increasingly apparent to those of the Cawnpore public who had not yet deserted the ekka. It was a matter of satisfaction to them as local agents to be able to say that not a single fatal accident had occurred, and there had only been one accident of any kind, due to failure on the part of the injured man to obey rules.

The report was adopted.

Madras Electric Supply Corporation.

Mr. Arthur M. H. Walrond presided on Wednesday last week over the first annual general meeting of this company, held at Salisbury House.

The Chairman, in moving the adoption of the report, said they would notice that the interest received on deposits had amounted to the respectable sum of £2,151, the high rates for money ruling last year being to their advantage. Since the report considerable progress had been made with the buildings, but they were sorry to have to tell them that, owing to the stringency of the local by-laws, and the subsoil in Madras necessitating very heavy foundation work, especially for buildings such as theirs, where heavy weights were to be installed, they had been compelled to increase the contract price to a considerably larger figure than they originally anticipated; and it was found impossible to reduce the sum below £23,700. The contractor was set to work at once, and they hoped that before the end of the year the buildings might be completed. As somewhat of a set-off to that extra cost they had secured a very considerable piece of land for the site of the main station (some fifteen acres in extent) from the Government of Madras at a nominal figure. They had satisfactory reports from their engineer as to the laying of the mains, and they hoped that part of the work would be finished by the end of August. They had appointed Mr. Scott Mackenzie (late chief engineer of the Government Electricity Works at Dacca, and who had worked some years in India), as their assistant engineer. He was now in this country, and reported that their contractors (Messrs. Crompton & Co., Ltd.), were well forward with all their work. After much consideration, they had settled on a table of charges for electrical energy to meet every want, whether for power or lighting, on the basis of a flat rate, and those charges had been kept as low as they possibly could in order to popularise the use of electricity. They were very pleased to be able to report that apparently that policy had been justified, as the demand for current appeared to be very great. It was early to say much on that point yet, but in consequence of a demand for a supply to the Government Maternity Hospital they had found it necessary to send out temporary plant (consisting of oil engine sets, switchboard, &c.), with which they hoped to commence supply to a certain number of customers at the end of this month or the beginning of July. He might add that they had applications from nearly 300 private consumers. They were also encouraged by the demand for current for power purposes, and were at the present moment negotiating with several large consumers, which they hoped might result in profitable business for the company. In this connection they were about to enter into an agreement with the Madras Tramways Co. to supply them with all the current they required for the working of the

tramways, with a minimum consumption of 1 million units per annum, and that contract was for the whole period of their concession so long as they were in a position to supply the current. In order to get that contract they would have to invest £20,000 of their funds in 4½ per cent. preferred ordinary shares in the tramways company, and one of their directors would join the board of that company. That arrangement was arrived at after very considerable negotiations, and inasmuch as the tramways were now earning a dividend on their ordinary shares, after paying the preferred dividend, under conditions that were not too favourable. They had little doubt that, under new conditions and management, their earnings could be considerably improved, and that besides securing the supply of current, the shares themselves should pay them well, as after the preferred ordinary shares had earned their 4½ per cent., all further profits were to be divided, as to one-third to the preferred ordinary and two-thirds to the ordinary shareholders. The board hoped that they would approve of that arrangement. In conclusion, he might tell them that Mr. Ivens had returned from Madras with encouraging reports as to the future of the company.

Sir WILLIAM J. CUNINGHAM seconded the motion, and the report was adopted without discussion.

South Metropolitan Electric Tramways and Lighting Co., Ltd.

THE ninth ordinary general meeting was held on Monday at Donington House, Mr. C. G. Tegetmeier presiding.

In moving the adoption of the report, the CHAIRMAN reminded the shareholders that that meeting was the first since the issue of the capital. The capital expenditure for the year amounted to £320,720, of which £6,539 was expended on the electricity supply undertaking, and £314,181 in connection with the construction of tramways. Including the costs and expenses and the debenture and preference stock issued, the total expenditure up to December was £446,782. The expenditure for the year was inclusive of liabilities to the contractors for work performed, but payment of which had not become due under the terms of the contract. The item £64,286, sundry creditors and balances, was largely made up of liabilities of that nature, and they would observe that £24,837 had been advanced to contractors in anticipation of amounts falling due under contracts. It was satisfactory to know that the whole of the works would be completed within the estimates mentioned in the prospectus of the company. The estimates then made did not include the construction of the section of line at Sutton to Mitcham, and it cost them over £32,000 for street widenings over about ½ mile of the 5 miles, which was the total length. Owing to the exacting conditions made by the Sutton Council, the company had abandoned their intention to construct a line in the district of Sutton. He thought it was a great restriction that they should have to bear the whole of the cost of street widenings. At the close of the year the whole of their lines—13 miles—were in operation. Until June 1st last the lines in the west of Croydon were leased to the B.E.T. Co., but that agreement had now terminated, and arrangements had been made with the Croydon Corporation, whereby the cars of the company would run from Crystal Palace High Level entrance to West Croydon station and the cars of the Corporation *vice versâ*. Such arrangement, he thought, would be of mutual advantage to both parties. The Croydon to Tooting section was completed on October 12th, thus giving a through service from Tooting to West Croydon station. The cost of street widenings on the line amounted to £11,000 out of the £80,000 required for construction and electrical equipment. He was pleased to say that the L.C.C. were now constructing a section of tramways at Tooting about half-a-mile in length, which would link up both their system and the L.C.C.'s. They had spent £25,000 on street widenings for the Croydon to Sutton section, which was completed on December 31st. The traffic had been interfered with on that section through the falling of a telephone pole, which brought a considerable portion of their overhead equipment down. Notwithstanding various inconveniences the company carried 3,354,433 passengers, and the traffic receipts amounted to £17,724, and he thought that those figures were as favourable as they could expect. With regard to the electrical supply undertakings, the gross receipts totalled £5,435, an increase of £1,513 over the previous year, and the connections to the mains represented an increase of 40 per cent. over 1905. The company were in a position to supply a larger amount of power than they at present did, and the business was capable of great development. After deducting all expenses chargeable to revenue, including £1,860 for interest on the debenture stock, and providing for payments to local authorities £778, there remained a surplus of £4,717, and after adding the amount brought forward from last year £603, they had an available balance of £5,321. The payment of a dividend on the preference shares and ordinary shares would absorb £4,982, leaving £339 to be carried forward. In conclusion, he referred, with regret, to the sad accident which occurred on their lines at Croydon last Easter Monday, and mentioned that the whole of the pecuniary loss was covered by insurance.

Mr. J. DEVONSHIRE seconded the motion, and the report was adopted without discussion.

The report to December, 1906, showed that the capital was increased to £400,000, and the existing £10 shares were divided into 10 shares of £1 each. A further issue of capital was made in May, 1906, of £150,000 4 per cent. debenture stock at the price of £90 per £100 stock, and 150,000 6 per cent. cumulative preference shares of £1 each at par. These shares and debentures were granted an official quotation in November. The capital expenditure at December 31st, 1906, amounted to £446,783.

After deducting all expenses chargeable to revenue, including £1,860 for interest on the debenture stock of the company, and providing for payments to local authorities under agreements amounting to £778, there remains a surplus of £4,718, making, with the £603 brought forward, an available balance of £5,321. The dividend on the preference shares to December 31st, 1906, paid on February 1st, 1907, required £4,982, and left a balance of £339, which is to be carried forward.

The amount paid for dividend on the preference shares includes the arrears of dividend on the previous issues of shares at 31st December, 1905, which amounted to £2,070.

The whole of the Penge section, about 2¾ route miles of double track, was not opened for public traffic until May of last year. On May 31st, 1906, the Croydon Corporation terminated the lease of the tramways worked by the B.E.T. Co., and since that date this company's cars have only run to the Croydon boundary. Since the close of the year an agreement has been concluded by the company with the Croydon Corporation which provides for mutual running powers, whereby the cars of the company will run from the Crystal Palace High Level entrance to West Croydon Station, and the cars of the Corporation will run from West Croydon Station to the Penge entrance to the Crystal Palace. The inconvenience that passengers have experienced in having to change cars at the Croydon borough boundary will henceforth be avoided.

The Croydon to Tooting section comprises about 5¼ route miles of double track. The first portion—4 miles—was opened for traffic on May 26th, 1906, another mile of track was opened on July 14th, and the remainder (¼ mile) on October 12th, from which date a through service was given from West Croydon Station to Tooting.

The Croydon to Sutton section comprises five route miles of double track; 4½ miles were opened for public traffic on November 10th, 1906, and ½ mile was opened for public traffic on December 21st, 1906, so that the company only had the benefit of the complete section for traffic for about 10 days during the period under review.

The undertakings authorised by the Croydon District Electric Tramways Acts 1902 and 1903, and the Mitcham Light Railway Order, 1901, were obtained by the B.E.T. Co., and are at present held in trust by them for the company.

As the tramways and light railways constructed under those powers have now been opened for traffic for a period of six months, a formal application has been made to the Board of Trade for their consent to the transfer of the undertakings to this company.

The gross receipts on all sections from their respective dates of opening to December 31st, including advertising, amounted to £17,820, and the working expenses to £12,022.

Electrical energy for working the Penge Tramways is supplied under agreement by the Beckenham U.D.C., while the supply to the Tramways and Light Railways in the Borough of Croydon and in the Croydon Rural District is furnished, under the provisions of the Act of Parliament, by the Croydon Corporation, the remainder of the tramways being supplied with energy from the company's own generating station.

The results from the year's working of the electricity supply section continue to show satisfactory progress. The gross receipts amounted to £5,435, and the expenditure to £2,764. The receipts for 1906 exceeded the receipts for 1905 by £1 513, while the expenditure amounted to £730 in excess of that for 1905.

The installations connected to the mains represent the equivalent of 27,379 8-C.P. lamps, an increase of 40 per cent. Additional plant has been, and is in course of being, installed in the company's generating station, bringing the total up to 1,550 KW. of plant.

	Year ended Dec. 31st, 1906.
Miles opened—	
Route miles	13·09
Single line	0·19
Double line	12·90
Number of passengers carried	3,354,731
Average traffic receipts per passenger	1·26d.
Number of cars in stock	49

Official Announcements re Companies.

THE following companies have been struck off the register, and are dissolved:—

Birmingham Telegraph Factory, Ltd.
Cross Electric Engineering and Manufacturing Co., Ltd.
Electrical Engineering Corporation, Ltd.
Elmore's French Patent Copper Depositing Co., Ltd.
Fowler, Lancaster & Co., Ltd. (registered January 8th, 1890).
India-Rubber Estates Co., Ltd.
Lamina Accumulator (Ellieson's British Patents) Syndicate, Ltd.
Lartigue Railway Construction Co., Ltd. (registered August 26th, 1890).
Medical Battery Co., Ltd. (registered May 6th, 1889).
Poole & White, Ltd.
Postal and Telegraph Employés Supply Corporation, Ltd.
Practical Electro-Plating and Enamelling Co., Ltd.
S. Z. de Ferranti, Ltd.
Sheffield Telephone Exchange and Electric Light Co., Ltd. (registered August 28th, 1890).
Weybridge Electric Supply Co., Ltd.
Williamson Electrical and Engineering Co., Ltd.
Woodhouse & Rawson United, Ltd.

The following are to be struck off within three months unless cause is shown to the contrary:—

Herculite and Electrical Manufacturing Co., Ltd.
Printing Telegraph and Construction Co. of the Agence Havas, Ltd. (registered January 12th, 1893.

Electric and General Investment Co., Ltd.—This company's meeting was held on Wednesday, Mr. Braithwaite presiding. In the course of his remarks he referred to the rejection of the L.C.C. Bill that morning, and said that "may be they would now be left in peace for a time." The meeting called for considering the reconstruction of the company was adjourned *sine die*. Our report will appear next week.

British Columbia Electric Railway Co., Ltd.—The registered offices of this company have been removed to 34, Nicholas Lane, Lombard Street, E.C.

J. G. White & Co., Ltd.

The report of the directors to February 28th, 1907, states that the profit for the year is £38,378, showing a steady improvement on previous years' results. The business has continued to show considerable development in the foreign field, and the company is now actively carrying out works in Buenos Aires, Montevideo, Para (Brazil), Caracas (Venezuela), and Bombay. Very little business is offering in Great Britain, but the directors hope with the present outlook for foreign business and the continued development and widening of the scope of the company's legitimate fields of operation to offset any diminution in the volume of British contracting business. The total contract value of work which the company has in hand at the date of this report, exclusive of work on which profits have been taken at February 28th last, is in excess of £1,500,000. The operating and finance departments have been further developed during the year under review, and the directors see no reason to change their opinion that considerable profits can be obtained from these branches of the business. The investments are valued on what is believed to be a conservative basis, and it is anticipated that a considerable profit will be made in realisation. The securities have been obtained in the ordinary course of the company's contracting and financial business, and as in a good many instances the properties have yet to develop, the valuations are considerably under par, but the directors have pleasure in stating that the yield in interest and dividends received and accrued during the year is in excess of 5 per cent. on the valuation. During the year sales were made of securities valued at £18,914, at February 28th, 1906, yielding a substantial profit. Since the date of the balance-sheet sales have been made and agreements completed for disposing of securities valued at £13,000 on a basis which will realise a considerable profit for the current year. The business of the Waring White Building Co., Ltd., continues to improve and has shown satisfactory progress. The available balance to the credit of the account, after bringing in £16,357 from the previous account, deducting the interim dividend paid on the preference shares at January 1st, 1907, and making provision for the percentages due to the directors and staff, is £47,812. The directors recommend a dividend free of tax at the rate of 6 per cent. per annum on the cumulative preference shares for the half-year to February 28th, 1907, requiring £4,500, and at the rate of 6 per cent. per annum on the ordinary shares for the year, requiring £3,000, together with a bonus of 1 per cent. on the full amount of the preference and ordinary share capital, absorbing £2,000. There is placed to reserve £20,000, and carried forward £18,312.

Diesel Engine Co., Ltd.

Mr. C. C. Ellis presided at this company's meeting on the 13th inst., and in moving the adoption of the report he said that the patents had now been written down quite low enough—from £350,000 to £90,000. The company's financial position was now eminently satisfactory, and 5 per cent. was to be paid on both the ordinary and preference shares. They could have made a larger distribution, but it was prudent to carry forward a substantial sum. During the last three months of the year under review the company had obtained orders for engines to the extent of £74,887, while in the whole of the year ended March, 1906, they obtained orders to the amount of only £82,517. The company had purchased a licence for a reversing plant, which was applicable to motor omnibuses, and in various other ways. At March 31st the company had orders for engines amounting to 10,000 H.P., and since then that figure had been brought up to 11,500 H.P.

Anglo-Portuguese Telephone Co., Ltd.

The directors' report for the year ending December 31st, 1906, says that the growth of revenue, which had been a marked feature of the company's business for some years past, was well maintained in the period under review. As in the previous year, the profit and loss account was credited only with the proportion of subscriptions for which the company had actually rendered service during the year. The proportion of the year's subscriptions unearned at December 31st, amounting to £12,904, had been treated in the balance-sheet as a liability of the company.

The revenue results for the past three years were:—

Year.	Gross revenue.	Gross profits.	Net profits.
1904	25,962	10,796	8,360
1905	29,808	12,284	9,702
1906	34,091	14,772	10,696

The accounts for the past year have been charged with a sum of £3,600 for the debenture service (£2,500 interest, and £1,100 sinking fund), compared with a similar charge of only £2,281 in 1905. Including £5,458 brought forward from the previous year, the total amount available for disposal is £16,154. In December last the directors paid an interim dividend of 3 per cent., amounting to £2,999. They now recommend the proprietors to declare a final dividend of 4½ per cent., free of income-tax, making a total distribution of 7½ per cent. for the year 1906. This will absorb a further sum of £4,500, and of the balance it is recommended that £5,000 be placed to reserve (increasing the same to £10,000), and that £3,655 be carried forward. The extension of the company's system south of the Tagus was continued during the year, and has been fully justified by the results. The directors have decided further to extend the company's system of underground cables in Lisbon and Oporto. Since the commencement of the present year there has been a continuous improvement in the business of the company. The company's relations with the Government and the various administrative authorities remain quite satisfactory.

United Electric Tramways of Montevideo.

Mr. G. A. Touche presided at this company's meeting. He said that the gross receipts were $364,892, an increase of $14,939, while the expenses advanced from 73·25 per cent. to 77·85 per cent. The increase in the expenses was owing to three causes, of which two would finally disappear with electrification. Montevideo was becoming more popular and populous every year, and as pioneers of electric traction in the city, their company ought to reap a very substantial reward. Rapid progress was being made with the work of electrification, so far as the original lines were concerned, and these, when electrified, with the extensions, would represent over 89 kilometres of single track. The inauguration of the electric service took place on November 19th last. Plans for the electrification of the Union lines had been completed, and had been submitted to the Government for approval; and a supplemental contract had been entered into with the contractors for the original line for the reconstruction, with certain extensions, of the Union system, which represented another 39 kilometres. The whole of the lines ought to be completely electrified by March 31st next. Their experience of electrical running had been limited, but the effect on the takings had been very marked. The gross receipts for the six months ended April 30th last, including those of the Union system, amounted to £106,841, exhibiting an increase of £36,188 on those of the corresponding period of last year, while the net receipts were £40,138, showing an advance of £17,930. With the equivalent of less than one-fifth of the line electrified over the whole period, the gross receipts had gone up over 50 per cent. and the net receipts over 80 per cent. Over 81 kilometres out of 128 were still to come into electrical operation. A dividend of 2 per cent. on the ordinary shares was to be paid for the year ended March 31st. It was something to go on with during the period of electrification and reconstruction.

Prospectuses.—*South Metropolitan Electric Light and Power Co., Ltd.* The directors have this week been offering to existing shareholders and debenture-holders a further £30,000 4½ per cent. first mortgage debenture stock at £102, and a further 30,000 7 per cent. cumulative preference shares of £1 each at 22s. 6d. The capital is being issued in order to provide for the payment for the new power house at Blackwall Point, which is now working, and to meet the continuous expansion of the company's business.

United River Plate Telephone Co., Ltd.—The list was to close yesterday in an issue of £300,000 4½ per cent. debenture stock at par for the two-fold object of redeeming £164,247 of existing 5 per cent. debenture stock at £110 per cent., and providing for the development of the company's business.

Greenwood & Batley, Ltd.—The report for the year ended March 31st states that the result of the year's trading is not satisfactory. After providing for debenture interest and expenses of management, and making provision for doubtful debts, the accounts show a profit of £12,428, making, with the balance brought forward, £18,552. The directors have written off £4,000 for depreciation, and recommend a dividend for the year ended March 31st at the rate of 4 per cent. per annum, leaving £654 to carry forward. Last year the dividend was 5 per cent.

Adelaide Electric Supply Co., Ltd.—Special meetings of the different holders are to be held on Monday, July 1st, to sanction the issue of 15,000 further preference shares.

Provincial Tramways Co., Ltd.—A dividend of 3s. per share is to be paid on the ordinary shares on account of the profit which is expected to be made in the year ending September, 1907.

Cape Asbestos Co., Ltd.—Mr. L. Breitmeyer, presiding at the meeting of this company in London on Monday, said that the company's affairs had taken a fair turn. The items on the debit side were now practically balanced by the credit items.

France.—La Société Lyonnaise des Forces Motrices du Rhone, of Lyons, reports a profit of £77,561 for the last financial year, and is declaring a dividend of 21 fr. per share.

Anglo-Argentine Tramways Co.—The directors in a circular to the shareholders state that an offer has been received from the Compagnie Générale de Tramways de Buenos Aires to transfer to this company the undertaking of the Buenos Aires and Belgrano Electric Tramways Co. on what they regard as favourable terms. The company's solicitors have been instructed to prepare the necessary legal documents in order that the proposal may be submitted to the shareholders for approval.

North Staffordshire Tramways Co., Ltd.—The report for the year ended December, 1906, states that capital expenditure of £4,242 has been incurred in doubling certain sections of the tramway to meet increased traffic. The liability to the Potteries Electric Traction Co. on this account was £23,628. The directors propose a dividend on the ordinary shares of 5 per cent., and to carry forward £815.

Harper Electric Piano Co., Ltd.—The report for the year ended June 1st states that the sales have been very satisfactory. After providing for dividend on the preference shares at the rate of 10 per cent. per annum, £217 is carried forward.

Eastern Extension Australasia and China Telegraph Co., Ltd.—An interim dividend for the quarter ended March 31st last of 2s. 6d. per share is announced.

Eastern Telegraph Co.—A first quarterly interim dividend of 1¼ per cent. on the ordinary stock is declared.

MARKET QUOTATIONS.

Wednesday, June 26th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a " Nitric	per cwt.	22/-	..
a " Oxalic	per cwt.	£8/-	6/- dec.
a " Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	..
a " "	per ton	£30	..
a Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£18	..
a Borax	per ton	£15	..
a Copper Sulphate	per ton	£33 10	..
a Lead, Nitrate	per ton	£24	10/- dec.
a " White Sugar	per ton	£25	..
a " Peroxide	per ton	£32	..
a Methylated Spirit	per gal.	2/6	..
a Potassium Bichromate, in casks	per lb.	8½d.	..
a Potash, Caustic (75/80 %)	per ton	£20	..
a " Chlorate	per lb.	3½d.	..
a " Perchlorate	per lb.	9d.	..
a Potassium Cyanide	per lb.	7½d.	..
a Shellac	per cwt.	220/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 10	..
a " Recovered	per ton	£5 10	..
a " Lump	per ton	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	..
a " Chlorate	per lb.	3½d.	..
a " Crystals	per ton	£3 5	..
a Sodium Bichromate, casks	per lb.	8d.	..
a " Cyanide (basis 100 %)	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£200	..
b " Wire, in ton lots	per ton	£220	..
b " Sheet, in ton lots	per ton	£210	..
p Babbitt's metal ingots	per ton	£60 to £195	..
c Brass (rolled metal 2" to 12") basis	per lb.	10½d.	..
c " Tube (brazed)	per lb.	1/-	½d. dec.
c " " (solid drawn)	per lb.	10½d.	½d. dec.
c " Wire, basis	per lb.	10½d.	½d. dec.
c Copper Tubes (brazed)	per lb.	1/1½	½d. dec.
c " " (solid drawn)	per lb.	1/1½	½d. dec.
g Copper Bars (best selected)	per ton	£113	£3 dec.
g Copper Sheet	per ton	£115	£3 dec.
g " Rod	per ton	£113	£3 dec.
e " (Electrolytic) Bars	per ton	£107	£5 dec.
e " " Sheets	per ton	£116	£5 dec.
e " " Rod	per ton	£112	£5 dec.
e " " H.C. Wire	per lb.	1/1	½d. dec.
f Ebonite Rod	per lb.	8/8	..
f " Sheet	per lb.	8/-	..
n German Silver Wire	per lb.	1/8	..
h Gutta-percha, fine	per lb.	5/8 to 6/6	..
h India-rubber, Para fine	per lb.	4/7½	½d. inc.
i Iron, Charcoal Sheets	per ton	£18	..
i " Pig (Cleveland warrants)	per ton	56/1½	2/9½ dec.
i " Forgings, according to size	per ton	From £11	..
i " Scrap, heavy	per ton	47/6 to 50/-	..
i " Wire, galvanised No. 8	per ton	£9 15	..
g Lead, English Ingot	per ton	£20 7 6 to £20 10	15/- inc.
g " " Sheet	per ton	£20 15	15/- inc.
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£6 16 to £7	..
d Mica (in original cases) small	per lb.	6d. to 1/-	..
d " " " medium	per lb.	2/6 to 4/-	..
d " " " large	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/4½ to 1/6½	..
p " rolled bars & rods	per lb.	1/5½ to 1/6½	..
p " " strip & sheet	per lb.	1/6 to 1/10	..
o Platinum	per oz.	100/-	..
e Silicium Bronze Wire	per lb.	1/8½	..
Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
" " in bars		£15 to £40	..
g Tin, Block (English)	per ton	£190 10 to £191 10	£2 10 inc.
n " Wire, Nos. 1 to 16	per lb.	2 3	½d. dec.
p White Anti-friction Metals—			
"White Ant" brand	per ton	£56 to £80	..
k Zinc, Sh's (Vieille Montagne bnd.)	per ton	£30 10	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Teleg. Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

STOCKS AND SHARES.

Tuesday Evening.

In some respects the opening of the new Hampstead, Euston and Charing Cross Railway is the principal feature of the week, so far as electrical issues are concerned. It was noteworthy as affording Mr. Lloyd-George an opportunity for saying that the Government had nothing in its mind that should cause fear to the honest investor in any legitimate enterprise. Noteworthy, too, because it gave Sir Edgar Speyer the chance of holding out an invitation to municipalities to take a hand in the underground railway business. As regards the Minister's statement, the unkind comment of the Stock Exchange was to put nothing better upon its account. As regards Sir Edgar Speyer, the railway market treated his suggestion as something that bordered on the humorous. "No doubt," observed one shrewd jobber, "the Speyer group would be extremely glad to get municipal authority to relieve the group of some of their piles of underground stock;" and he added, "I shouldn't wonder if Speyers might not be induced to part with it at a price well below the nominal value." While another Stock Exchange member interested in the matter, upon being asked what he thought of the idea of Sir E. Speyer, replied as colloquially as laconically "Cheek!"

And the 5 per cent. profit-sharing notes of the Underground Electric Railways Company of London have fallen six more points to 62½.

The 4 per cent. Debenture stock of the newly-opened line stands at 81½, Great Northern, Piccadilly and Brompton Debenture is 83½, and Bakerloo Debenture 92½.

Metropolitan Railway Consolidated stock continues to crumble, the price declining to 41, and Districts at 11½, are also lower. The proposed re-arrangement of the fares has spent its force as a bullish factor, and the public do not seem inclined to take a fresh hand in the stocks of the companies concerned. Central London Ordinary has fallen a point to 73, despite the general satisfaction expressed that the company should have come into harmonious agreement with the District group. City and South London stock has again risen to 46. The gilt-edged market was greatly stiffened by a remarkable jump in the price of Consols, but railways rather lagged behind in the general advance.

New issues made within the past few days embrace the offer by the South Metropolitan Electric Light and Power Company of £30,000 4½ per cent. Debenture stock at 102, and 30,000 7 per cent. Preference shares at 22s. 6d., to its shareholders. The quotations for the existing similar securities of the company are 101½ and 25s. respectively, from which it is evident that not much is being given away. Another new issue, offered for public subscription, was £300,000 in 4½ per cent. Debenture stock at par by the United River Plate Telephone Company.

Electricity Supply shares look on indifferently to the London County Council's electrical power discussions. There has been but little alteration in the prices since last we wrote. The fraction lost by London Electric Preference a week ago has been replaced. Metropolitan fell to 6¼. The list keeps steady, or listless, whichever adjective may be preferred to describe conditions of profound stagnation.

At last the eagerly-anticipated Anglo-Argentine Tramway proposals are out, and at first sight they appear to be curiously involved. The Anglo-Argentine has been offered by the Compagnie Générale de Tramways de Buenos Ayres, the shares owned by the latter in the Buenos Ayres and Belgrano. Various advantages are offered in the way of advanced interest upon certain of the Anglo-Argentine shares, and it is patent that the foreign company, as middleman, will reap a handsome reward if the shareholders agree to the transfer. In the market the prevailing impression is that the scheme may be considered favourable, and likely to work out in practice much as anticipation had forecast. This view is reflected in the quietness of the prices. Anglo-Argentine Ordinary at 3¼ better, and Belgranos at 4-1/16 are 3/16 shade up. The 6 per cent. Debenture stock of the former company has advanced a point to 135½.

Business was done on Monday in British Electric Tractions at 50s., and this is the middle price, showing a 10s. drop on the week. The First Debenture Stock was marked up 2, while the Second Debenture lost 1. British Columbia Electric Deferred stock at 122½ is 2½ lower.

Telegraph descriptions are down in a good (or bad) number of cases. Eastern Ordinary fell 1, Eastern Extension shares ¼, Anglo-Americans ¼ to ½, Western Telegraphs ½, and so on. The necessity for realising investment stocks in order to pay losses incurred elsewhere is probably the reason for this dulness, except, of course, as regards Anglo-American Deferred—that gambling counter. The Trust varieties are steady, but Mackay Common stock fell 3 and the Preferred 1½, upon sales said to be of American origin.

National Telephone Deferred is a little weaker, and the new Debenture issue made Oriental Telephone Ordinary 1/16 lower at 1-5/16. United River Plates are without change.

In the Miscellaneous list, Babcock & Wilcox Ordinary were rather offered on the eve of the settlement, and at 3¾ the price shows ¼ loss. British Aluminium 7 per cent. Preference are recovering their dividend, and Telegraph Constructions at 30½ are the fraction lower, in sympathy with the weakness prevailing in the Telegraph list as a whole.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Class or Share.	Dividends for the last four years.				Closing Quotation June 18th.	Closing Quotations June 25th.	Business done week ended June 25th, 1907.		Rise + or Fall —	Present Yield per cent.
			1903.	1904.	1905.	1906.			Highest.	Lowest.		£ s. d.
35,000	Amazon Telegraph Co.'s shares, Nos. 1 to 35,000	10	Nil	Nil	Nil	..	8 — 8¼	8 — 8¼	..	..	..	Nil
149,600	Do. do. 5 % Debs., Nos. 1 to 1,280 Red.	100	Nil	Nil	5 %	5 %	88 — 91	88 — 91	..	..	..	5 9 11
660,660	Anglo-American Telegraph	Stock	6½	6½	6½	6½	61½ — 64½	61 — 64	61	..	— ½	6 1 1
8,169,670	Do. do. do. 6 % Pref.	Stock	6 %	6½ %	6 %	6 %	107½ — 108½	107½ — 108½	108	107	..	5 10 10
8,169,670	Do. do. do. Deferred	Stock	2s.	Nil	1½ %	1½ %	19½ — 19⅝	19 — 19½	19 7/16	18⅝	— ½	8 19 6
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	..	5 %	..	99 —101	99 —101	..	..	..	4 19 0
44,000	Chili Telephone, Nos. 1 to 44,000	5	7 %	8 %	8 %	..	6½ — 7½	6½ — 7½	9 3/8	9 2/4	..	5 10 4
2,097,680	Commercial Cable Sling. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	92 — 94	92 — 94	93¾	92¾	..	4 5 1
16,000	Cuba Telegraph	10	0	5 %	5 %	..	7⅜ — 8¼	7⅜ — 8¼	..	..	..	6 1 3
6,000	Do. 10 % Pref.	10	15 %	10 %	10 %	10 %	15½ — 16½	15½ — 16½	..	..	..	5 19 5
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜ — 3⅝	3⅜ — 3⅝	..	..	..	5 8 6
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	9¼ — 9½	9¼ — 9½	..	..	..	5 8 1
80,000	Do. do. 4½ % Debs.	50	4½ %	4½ %	4½ %	4½ %	100 —103	100 —103	..	..	..	4 7 5
60,7101	Direct United States Cable	20	8 %	8½ %	4½ %	..	15½ — 15⅝	15½ — 15⅝	15⅝	15⅜	..	5 7 11
60,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200,R.	100	4½ %	4½ %	4½ %	4½ %	100 —102	100 —102	..	..	..	4 8 3
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	136 —141	135 —140	139½	136¾	— 1	5 0 0
2,000,000	Do. 5½ % Pref. Stock	100	5½ %	5½ %	5½ %	5½ %	89 — 91	89 — 91	91	89	..	3 16 11
1,896,706	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	104½ —106½	104½ —106½	..	..	..	3 15 2
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	13⅝ — 13⅞	13⅝ — 13⅞	13 7/8	13	— ½	5 6 8
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	104½ —106½	104½ —106½	..	..	..	3 15 2
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	98 —101	98 —101	99	98¾	..	3 19 3
200,000	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	98 —100	98 —100	..	..	..	4 0 0
181,127	Globe Telegraph and Trust	10	5½ %	5½ %	5½ %	5½ %	10⅝ — 11⅜	10⅞ — 11⅜	11 1/16	10⅞	..	4 17 9
181,127	Do. do. 6 % Pref	10	6 %	6 %	6 %	6 %	13⅜ — 14⅜	13⅜ — 14⅜	13⅝	13 1/16	— ⅛	4 4 11
150,000	Great Northern Telegraph, of Copenhagen ..	10	15 %	24 %	20 %	20 %	84 — 86	84 — 86	..	..	..	5 11 1
88,500	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100 —102	100—102	..	..	..	4 8 3
17,0'0	Indo-European Telegraph	25	10 %	12 %	13 %	13 %	56 — 58	56— 58	..	..	..	5 12 1
$41,380,400	Mackay Companies Common	$100	..	1 %	2 %	3½%	71 — 73	68 — 70	..	..	—3	5 0 0
$50,000,000	Do. do. 4% Cum. Pref.	$100	..	4 %	4 %	4 %	69 — 71	67 — 70	..	..	—2	5 14 4
206,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	⅞ — ⅞	⅞ — ⅞	12/1½	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	8 %	4 %	5 %	..	1⅛ — 1⅛	1⅛ — 1⅛	..	..	..	4 14 1
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	⅞ — 1	⅞ — 1	..	..	..	5 0 0
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	108 —110	108 — 110	108¼	..	..	5 9 1
2,225 000	Do. do. Def. Stock	100	5 %	5 %	5 %	5½ %	105 —107	104 — 106	105½	104½	—1	5 3 9
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	11½ — 12½	11½ — 12½	..	..	..	4 8 11
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	5 %	10 — 12	10 — 12	11½	11⅛	..	4 8 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,0 ..	5	5 %	5 %	5 %	5 %	5 5/16 — 5 7/16	5 5/16 — 5 7/16	..	..	..	4 9 11
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	95½ — 97½	95½ — 97½	97	96½	..	3 14 10
1,989,598	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100 —102	100 —102	101½	101	..	3 18 5
479,318	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6¾%	6¾%	7 %	7 %	1 5/16 — 1 7/16	1½ — 1⅝	..	..	— 1/16	5 1 10
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1⅛ — 1¼	1⅛ — 1¼	..	..	..	4 16 0
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	4 %	4 %	95 — 98	95 — 98	..	..	..	4 1 8
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..	3 19 3
11,886	Reuter's	8	5 %	5 %	5 %	5 %	7½ — 8½	7½ — 8½ xd	..	..	..	4 14 1
60,000	Telephone Co. of Egypt, 4½ % Deb. Red. ..	100	..	..	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
3,167	Submarine Cables Trust	Cer	6 %	6 %	6 %	6 %	127 —130	127 —130	..	..	..	4 12 4
60,000	United River Plate Telephone	5	8 %	8 %	8 %	..	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	5 10 4
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	..	5 — 5½	5 — 5½	..	..	..	4 10 11
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	108½—111½	108½—111½	..	..	..	4 9 ..
15,6091	West African Telegraph, Shares	10	4 %	4½%	4 %	4 %	10 — 10⅝	10 — 10⅝ xd	..	..	..	3 16 2
80,008	W. Coast of America, 1 to 80,000 & 88,001 to 88,008	2	Nil	Nil	Nil	2½ %	1⅜ — 1⅝	1⅜ — 1⅝	22/6	..	..	Nil
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
907,980	Western Telegraph, Ltd., Nos. 1 to 907,980 ..	10	7 %	7 %	7 %	..	13⅜ — 14⅜	13⅜ — 14⅜	14⅛	13⅜	— ⅛	4 19 1
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	102 —105	102 —105	..	..	..	3 16 2
28,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	3/16 — 1/4	3/16 — 1/4	..	..	..	Nil
84,668	Do. do. 6 % Cum. 1st Pref.	10	7 %*	6 %	5 %	8 %	7⅜ — 7⅝	7⅜ — 7⅝	..	..	..	10 0 6
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	6½ — 7½	6½ — 7½	..	..	..	Nil
80,000	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	100 —103	101 —104	..	..	+1	4 16 2

‡ Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, Nos. 260,008 to 510,007, and 560,008 to 580,007	..	..	8 %	8 %	8 %	7⅞ — 8⅛	8 — 8½	8 5/16	7⅛	+ ⅛	4 14 1
480,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	5½%	5½%	5½%	5½%	5⅝ — 6	5⅝ — 6	5 5/8	5 1/16	..	4 11 8
266,800	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	133 —136	134 —137	137	..	+1	4 7 7
985,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	104 —107	104 —107	106½	..	..	4 13 6
880,000	Babcock & Wilcox, 1 to 880,000	1	17 %	20%	20 %	20 %	3⅞ — 4	3⅞ — 3⅞	76/3	..	— ⅛	5 3 3
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..	6 7 3
88,000	British Aluminium, Ord., 2,001 to 40,000	5	..	7 %	7 %	7 %	5 — 5⅛ xd	5 — 5⅛	..	..	..	5 19 2
40,000	Do. do. 7 % Cum. Pref...	5	Nil	7 %	7 %	7 %	5¼ — 5⅜ xd	5⅜ — 5⅝	5⅜	5 1/16	+ ⅛	5 4 4
90,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	..	5⅛ — 5⅜	5¼ — 5⅜	..	..	..	4 14 1
40,000	Do. do. 4 % Funding Certs.	5	..	4 %	4 %	4 %	3⅞ — 4⅛ xd	3⅞ — 4⅛	..	..	..	4 17 1
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	..	100 —103	100 —103	..	..	..	5 8 11
800,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	5½%	98 —101	98 —101	99½	..	..	4 16 0
400,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	6 %	6 %	123 —127	120 —125	123½	..	2½	4 12 2
3 0,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	103½—108½ xd	103½—103½	107½	107	..	4 14 4
600,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	102 —106	102 —106	106¼	..	..	4 8 3
288,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 5 9
250,000	Do. 4½ % Vancouver Power Debs., 1 to 2,900	100	4½%	4½%	4½%	4½%	103 —105	103 —105	..	..	..	Nil
188,801	British Electric Traction	10	6 %	6 %	3 %	Nil	2⅜ — 3⅛	2⅛ — 2⅜	55/-	43/9	— ½	8 5 6
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	6⅞ — 7⅛	6⅞ — 7⅛	7⅛	6⅞	..	4 14 4
1,448,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	101 —104	103 —106	..	..	+2	5 11 1
10,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	4½%	4½%	4½%	79 — 82 xd	78 — 81	..	..	—1	4 8 3
100,000	British Insulated and Helsby Cables	5	8 %	8 %	8 %	10 %	6¼ — 6⅜	6¼ — 6⅜	..	..	..	7 8 2
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅞ — 6¼	5⅞ — 6¼	..	..	..	4 16 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	..	92 — 96	92 — 96	..	..	..	4 13 9
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	..	1 — 1½	1 — 1½	25/-	..	..	Nil
1 016,858	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	63 — 67	63 — 67	..	..	..	5 19 5
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	11/16 — 13/16	11/16 — 13/16	..	..	..	Nil
50,000	¶ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,781	Brush Electrical Engineering, Ord., 1 to 105,781 ..	2	Nil	Nil	24%	Nil	½ — ¾	½ — ¾	..	..	..	Nil
160,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	Nil	¾ — 1½	¾ — 1½	..	..	..	Nil
125,000	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	88 — 91	88 — 91	..	..	..	4 18 11
125,000	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	75 — 78	75 — 78	..	..	..	5 15 5
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	8 %	4 %	3 %	3 %	3⅜ — 4	3 5/8 — 4 3/16	78/9	76/3	+ 3/16	3 11 8
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	6 %	4⅛ — 5⅜ xd	4⅛ — 5⅜	..	..	..	5 17 1
27,500	Do "B" do. 1 to 27,500	5	6 %	6 %	6 %	6 %	4½ — 5¼ xd	4¼ — 5¼	..	..	..	5 14 3
18,200	Do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	105 —115	105 —115	..	..	..	4 6 11
190,000	Do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	101 —104	101 —104	..	..	..	4 16 2
137,610	Calcutta Trams., 1 to 137,610	5	6 %	8 %	8 %	8 %	7⅞ — 7⅞	7⅞ — 7⅞	7⅞	..	..	5 3 3
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,330	5	..	..	5 %	5 %	5¾ — 5¾	5¾ — 5¾	..	..	..	4 6 11
860,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	104 —107	104 —107	104½	..	..	4 4 1
85,000	Callender's Cable Construction shares	5	12½%	12½%	15%	15 %	9½ — 10½	9½ — 10½	10	9½	..	6 13 4
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	5⅜ — 5⅝	5⅜ — 5⅝	..	..	..	4 6 11
800,000	Do. do. 4½ % 1st Mort. Deb. Red.	Stock	4½%	4½%	4½%	4½%	106½—108½	106½—108½	..	..	..	4 2 11
491,222	Cape E. Trams., 1 to 491,222	1	10 %	5 %	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %	8 %	1⅛ — 1¼	1⅛ — 1¼	23/6	..	..	6 8 0
224,968	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	..	97 —102	97 —102	..	..	..	4 8 3
911,568	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	73 — 75	72 — 74	74½	73	—1	5 8 1
544,216	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %	92 — 94	92 — 94	..	..	..	4 5 1
544,216	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	53 — 56	53 — 56	45 13/16	44¾	..	7 2 10
1 480,000	City and South London Railway	Stock	2¾%	2¼%	1½%	2¼%	44 — 46	45 — 47	..	..	+1	4 10 5
85,000	Crompton & Co., Nos. 1 to 85,000	5	2¼%	2¼%	2½%	..	1 1/8 — 2 1/16	1 1/8 — 2 1/16	..	..	..	3 14 0
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	96 — 99	96 — 99	98	..	..	5 1 0

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated, all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued.)*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(Continued.)*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations June 18th.	Closing Quotations June 25th.	Business done week ended June 25th, 1907. Highest	Lowest.	Rise + or Fall —	Present Yield per cent £ s. d.
£												
250,000	Dick, Kerr & Co., 1 to 250,000	1	..	10 %	10 %	..	1⅝ – 1¾	1⅝ – 1¾	..	..	— 1/16	6 8 0
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	..	1 – 1¼	1 – 1¼	21/9	..	..	4 16 0
294,150	Do. do. 4½ % Deb. Stock	100	4½ %	4½ %	4½ %	4½ %	102 –105	102 –105	..	..	..	4 5 9
60,000	Dublin United Trams. (1896), 1 to 60,000	10	5½ %	6 %	..	..	13½ – 14½	13½ – 14½	..	..	..	4 2 9
59,987	Do. 6% Pref. between 1 and 60,000	10	6 %	6 %	6 %	..	13 – 14	13 – 14	..	..	..	4 9 3
99,961	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,961	5	Nil	2½ %	4½ %	..	1 – 1⅛	1 – 1⅛	..	..	..	10 0 0
17,189	Do. "A" shares, 01—017,189	5	Nil	2½ %	4½ %	..	2⅛ – 2¼	2⅛ – 2¼	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	85 – 87	85 – 87	..	..	..	4 12 0
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	89 – 92	89 – 92	..	..	..	5 8 8
113,100	Electric Construction 1 to 113,100	2	4 %	Nil	Nil	..	⅛ – ¼	⅛ – ¼	3/9	..	..	Nil
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	7 %	7 %	7 %	..	1½ – 1⅝	1½ – 1⅝	..	..	..	8 0 0
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	4 %	5 %	5 %	5 %	8½ – 8¾	8½ – 8¾	..	..	..	5 11 1
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	92 – 95	92 – 95	..	..	..	5 14 3
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	3 %	4 %	4 %	4 %	2 – 2¼	2 – 2¼	..	..	..	20 0 0
96,000	Greenwood & Batley 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10½ – 10⅝	10½ – 10⅝	..	..	..	6 13 4
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 –103	102 –103	..	..	..	4 17 1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15%	15 %	11½ – 12⅛	11½ – 12⅛	11 5/16	11½	..	6 0 0
200,000	Do. do. 4½ % Pref.	5	4½ %	4½ %	4½ %	4½ %	5 – 5⅛	5 – 5⅛	..	..	..	3 17 3
150,000	Do. do. 4½ Mort. Deb. Stock	Stock	4½ %	4½ %	4½ %	4½ %	105 –107 xd	105 –107 xd	..	..	..	4 4 1
50,000	India-Rubber, Gutta-Percha & Telegraph Works.	10	10%	5 %	10%	10 %	15 – 16	15 – 16	..	..	..	6 5 0
87,500	†Liverpool Overhead Railway, Ord.	10	1⅝	1½	Nil	Nil	1⅛ – 1⅜	1⅛ – 1⅜	..	..	— 1/8	Nil
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	6⅛ – 7⅛	6⅛ – 7⅛	..	..	..	6 13 4
600,070	London United Trams (1901), 1 to 50,007	10	8 %	6 %	8 %	8 %	6⅛ – 7⅛	6½ – 7⅛	..	..	..	8 8 7
899,930	Do. do. 50,008 to 100,000	10	8 %	6 %	8 %	8 %	6⅛ – 7⅛	6⅛ – 7⅛	..	..	..	5 2 2
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	7⅛ – 8⅛	7⅛ – 8⅛	..	..	..	5 14 3
1 331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	84 – 88	84 – 88	..	..	..	4 10 11
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	Nil	3/16 – 5/16	3/16 – 5/16	1/10½	..	..	Nil
600,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	5/16 – 7/16	5/16 – 7/16	18/-	17/9	..	5 3 11
350,000	Do. 4½ % Deb. Stock Red.	100	..	4½ %	4½ %	4½ %	96 – 99	96 – 99	..	..	..	4 10 11
80,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 80,000	5	..	6 %	6 %	6 %	3⅜ – 4½	3⅜ – 4½	..	..	..	7 1 2
215,500	Potteries E. Tro.	1	5 %	5 %	4 %	4 %	1/16 – 3/16	1/16 – 3/16	..	..	..	6 8 0
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/16 – 3/16	1/16 – 3/16	..	..	..	6 13 4
345,000	Do. 4½ % Deb. Stock	100	4½ %	4½ %	4½ %	4½ %	95 – 98	95 – 98	..	..	..	4 11 10
87,850	Telegraph Construction and Maintenance	12	90 %	15 %	15 %	15 %	80 – 82	80 – 82	30	29½	..	3 16 11
150,000	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	101 –104	101 –104	..	..	..	3 16 11
599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	5 %	5 %	5 %	67 – 70	61 – 64	..	..	—6	7 16 3
66,666	Willans & Robinson, 1 to 80,000 & 80,001 to 116,666	5	8 %	Nil	Nil	..	1⅛ – 1⅜	1⅛ – 1⅜	..	..	..	Nil
66,666	Do. 6 % C. P., 80,001 to 80,000 & 126,001 to 141,666	5	6 %	Nil	Nil	..	3¾ – 4	3¾ – 4	..	..	..	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	77 – 81	77 – 81	..	..	..	

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	5 %	5½%	5½%	5½%	4⅜ – 5⅛	4⅜ – 5⅛	..	..	..	5 4 9
71,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	98 – 100	98 – 100	..	..	..	4 10 0
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 30,000	5	10 %	10 %	10 %	10%	7⅞ – 8⅛	7⅞ – 8⅛	..	..	..	6 1 3
10,502	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7⅛ – 8⅛	7⅛ – 8⅛	..	..	..	4 2 4
836,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 –102	99 –102	..	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply	5	8 %	8 %	6 %	5 %	3 – 4	3 – 4	..	..	..	6 5 0
80,000	Do. do. 4½ % Cum. Pref.	5	4½ %	4½%	4½%	4½%	4 – 4½	4 – 4½	..	..	..	5 0 0
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅞ – 4⅜	3⅞ – 4⅜	..	..	..	5 5 11
427,400	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	94 – 97 xd	94 – 97	..	..	..	4 2 6
49,436	Chelsea Electricity Supply, Ord.	5	5½%	6 %	6 %	4½%	3¾ – 4¼	3¾ – 4¼	..	..	..	4 14 9
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	103 –106	103 –106	103½	..	..	4 4 11
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	6 %	6 %	6 %	9 – 10	9 – 10	9 5/16	9⅜	..	6 0 0
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11⅛ – 12⅛	11⅛ – 12⅛	..	..	..	4 18 0
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 – 126	123 –126	..	..	..	3 19 4
600,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	97 –100	97 –100	100	..	..	4 10 0
40,000	County of Durham Electrical Power, Ord.	5	4 %	£3 7 0	4 %	4 %	4⅛ – 5	4⅛ – 5	..	..	..	4 0 0
80,000	Do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	4⅛ – 5	4⅛ – 5	..	..	..	5 0 0
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4½%	6 %	6 %	7⅛ – 8⅛	7⅛ – 8⅛	..	..	..	5 17 8
40,000	Do. do. 6 % Pref., 40,001—80,000	10	6 %	6 %	6 %	6 %	10⅛ – 11⅛	10⅛ – 11⅛	11 3/16	11⅛	..	5 4 4
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	106 –109	106 –109	..	..	..	4 2 7
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	93 – 96	93 – 96	..	..	..	4 18 9
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	4 %	..	⅛ – 1	⅛ – 1	..	..	..	11 0 0
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	..	1½ – 2⅛	1½ – 2⅛	..	..	..	12 0 0
350,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	78 – 83	78 – 83	..	..	..	5 0 0
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅝ – 5⅛ xd	4⅝ – 5⅛	..	..	..	5 8 5
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	5 %	5 %	5 – 5⅛	5 – 5⅛	..	..	..	4 15 8
90,000	Do. 4½ % 1st. Deb. Stock	100	4½%	4½%	4½%	4½%	98 –101	98 –101	..	..	..	4 9 1
18,000	Hove, 1 to 18,000	5	8½%	8½%	9 %	9 %	7 – 7⅛ xd	7 – 7⅛	..	..	..	6 0 0
81,000	Kensington and Knightsbridge Electric Ord.	5	12½	12 %	10 %	10 %	8⅝ – 9⅛	8⅝ – 9⅛	..	..	..	5 0 0
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	97 –100	97 –100	..	..	..	4 0 0
1 11,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	3 %	4 %	4 %	1⅜ – 2⅛	1⅜ – 2⅛	..	..	..	5 6 8
70,000	Do. do. do. 6 % Pref...	5	5 %	6 %	6 %	6 %	4⅝ – 5⅜	4⅝ – 5⅜	..	..	+ 1/8	5 17 1
674,895	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	93 – 96 xd	93 – 96	94	..	..	4 18 9
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8½%	10 %	10 %	8 %	6 – 7	5⅞ – 6⅞	6	..	— 1/8	5 14 3
76,131	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅝ – 5⅛	4⅝ – 5⅛	..	..	..	4 8 9
290,000‡	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	105 –109	105 –109	..	..	..	4 2 7
280,000‡	Do. 3½ % Mort. Deben. Stock Redeem.	Stock	3½%	3½%	3½%	3½%	88 – 93	88 – 93	..	..	..	3 15 3
260,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	95 – 98	95 – 98	97	..	..	4 11 10
67,991	Newcastle-on-Tyne	5	8 %	8 %	8 %	8 %	7⅛ – 7⅜	7⅛ – 7⅜	..	..	..	5 3 8
75,000	Do. 5 % Pref., 1 to 75,000	5	5 %	5 %	5 %	5 %	5 – 6	5 – 6	..	..	..	4 3 4
10,000	Notting Hill Electric Lighting	10	6 %	7 %	7½%	7½%	12 – 13	12 – 13	..	..	..	5 15 5
20,000	Oxford, 1 to 96 and 407 to 20,310	5	6½%	7 %	7 %	7 %	6 – 6⅛	6 – 6⅛	..	..	..	5 7 8
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	96 – 98	96 – 98	..	..	..	4 1 8
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	12½%	10 %	7⅞ – 8⅛	7⅞ – 8⅛	..	..	..	5 17 8
30,000	Do. do. 7 % Pref. 20,001 to 40,000	5	7 %	7 %	7 %	7 %	6⅞ – 7⅛	6⅞ – 7⅛	..	..	..	4 13 4
1 0,000‡	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	88 – 93	88 – 93	..	..	..	3 15 3
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	Nil	1⅛ – 2⅛	1⅛ – 2⅛	..	..	..	Nil
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	73 – 77	73 – 77	..	..	..	5 3 11
65,000	South London Electricity Supply, Ord.	5	3 %	4 %	4 %	2 %	2 – 2⅜	2 – 2⅜	..	..	..	6 0 0
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	2⅜%	2⅜%	⅜ – ½	⅜ – ½	..	..	..	3 6 8
117,968	Do. Do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1⅝ – 1⅞	1⅝ – 1⅞	..	..	..	5 1 10
200,000	Do. Do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	100 –103	100 –103	..	..	..	4 7 5
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	1⅜ – 2⅛	1⅜ – 2⅛	..	..	— ⅛	11 2 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	2⅜ – 3⅛	2⅜ – 3⅛	..	..	..	7 2 10
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	4½%	4½%	4½%	94 – 97	94 – 97	..	..	..	4 12 9
110,000	Westminster Electric Supply, Ord.	5	13½%	14 %	12 %	12 %	9 – 10	9 – 10	9 5/16	..	..	6 0 0
81,279	Dr. do. 4½ % Cum. Pref.	5	5 %	5 %	5 %	4½%	5⅛ – 5⅜	5⅛ – 5⅜	5 1/16	5⅛	..	3 18 3
	(Original 5%- Red. to 4½ % from 31st Dec., 1905.											

Unless otherwise stated all shares are fully paid. Interim dividends.

Bank rate of discount 4 per cent. April 25th, 1907

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING MAY, 1907.

The returns of electrical business during the month of May show totals under the three principal headings as follows:—

Exports, £161,520; re-exports, £13,713; and imports, £147,001; and these compare with £164,924, £11,465, and £175,812 respectively for the preceding month, showing a comparatively small decrease of £3,000 approximately in the first, and a drop of nearly £30,000 in the last case.

In this connection it is very satisfactory to be able to record such high averages as £156,000 and £159,000 in the case of exports and imports respectively during the first five months of 1907; these compare with £134,000 and £147,000 respectively, the averages for the 12 months of 1906. The re-export averages during the same periods were practically level.

Of the various classes of goods exported, electrical and electrically-driven machinery maintains its premier position, closely followed, however, by electrical cables, which are some £13,000 above the April value; it is worth noting that Japan purchased nearly £12,000 worth of cables during the month. Only one small item of tramway material, an export, was recorded as such during May.

Of the imports, cables this month figure some £30,000 lower than last; a minor improvement is noticeable, however, in telephone, lamp, and carbon importations. We re-exported some £6,700 worth of foreign-made telephones during the month.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.*

Country receiving exports and importing.	Electrical goods and appliances.	Electrical cable.	Electric lighting fittings and accessories.	Electric lamps.	Electric meters and instruments.	Electric machinery.	Batteries and accumulators.	Carbons.	Telegraph and telephone material and electric bells.	Electrically-driven machinery	Tramways apparatus and materials.
	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark	762	2,197	7	197	371	3,431	75	5	4	11	...
Germany	120	3,436	91	40	80	278	...	32	206	164	...
Netherlands	82	2,673	419	102	104	211	6	18	36	...	...
Dutch Borneo and Java	126	...	174	9	3	101	...	...	68	...	...
Belgium	192	481	110	...	85	800	...	...	144	690	...
France	116	...	73	...	...	724	...	14	...	170	...
French Indo-China	...	25	...	38	...	...	...	4	...	...	...
Portugal, Azores, Madeira and Portuguese Africa	41	119	66	86	...	384	22	...	75	109	...
Spain and Canary Isles	58	63	63	49	23	446	77	...	15	...	...
Italy	66	...	804	...	595	1,535	...	...	...	...	...
Greece and Turkey	...	...	...	...	...	32	...	18	...	...	...
Egypt	336	3,104	181	...	...	849	116	36	14	245	...
China, Siam and Korea	314	1,405	160	104	9	1,297	7	...	229	217	...
Japan	175	11,947	126	...	526	4,781	...	...	5	2,674	...
U.S.A. and Philippines	242	803	133	68	153	1,098	...	8	...	...	...
Mexico and Central American States	60	723	...	3	...	830	...	...	...	2,195	...
Ecuador, Colombia, Venezuela Peru and Uruguay	167	47	260	40	81	390	...	150	17	494	...
Chile	239	328	17	136	...	1,293	775	...	242	...	...
Brazil	28	237	298	68	592	3,369	...	71	...	828	...
Argentine	1,497	2,011	72	351	57	1,487	120	...	1,062	2,582	...
Channel Isles, Gibraltar and Malta	316	5,500	177	14	19	442	...	3	41	...	...
British West Africa	144	24	...	...	15	60	15	...	12	...	...
Cape of Good Hope	855	1,244	469	206	90	3,094	4	16	28	...	...
Natal	2,474	4,841	905	822	505	2,229	148	27	2	145	...
British East Africa, Mauritius and Aden ...	69	334	79	44	36	52	6	...	44	...	...
India	1,520	9,795	1,408	956	1,236	12,535	219	85	171	907	152
Burmah	30	264	231	162	...	148	24	...	...	12	...
Ceylon	64	374	25	57	...	73	6	...	51	7	...
Straits Settlements, Fed. Malay States & Labuan	229	264	151	50	13	639	27	57	16	220	...
Hong-Kong	374	272	434	134	...	788	20	...	33	...	...
West Australia	129	7	234	10	358	728	181	...	146	...	...
South Australia	132	...	294	341	11	167	10	...	...	...	...
Victoria	455	465	405	195	135	1,005	15	...	63	857	...
New South Wales	1,838	493	335	781	191	3,215	86	6	106	172	...
Queensland	3	20	70	41	15	932	...	...	...	...	...
Tasmania	75	...	...	21	...	653	...	...	...	...	...
New Zealand	382	11	596	92	45	2,233	2	...	64	452	...
Canada	242	2,758	243	109	139	121	...	...	...	...	...
British West Indies and British Guiana ...	81	8	16	9	14	21	53	6	14	...	...
Total, £	14,033	56,273	9,126	5,335	5,501	52,471	2,014	556	2,908	13 151	152

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

	£	£	£	£	£	£	£	£	£	£	£
Russia, Norway, Sweden and Denmark	46	436	100	...	...	3,241	159	...	11,578	...	...
Germany	616	14,724	808	3,320	132	16,102	157	496	1,051	...	...
Holland	729	3,622	3,045	8,181	275	2,466	312	4,268	1,081	...	...
Belgium	3,394	3,130	408	1,542	363	14,636	307	1,061	9,302	...	...
France	309	6,017	3,197	1,790	1,007	2,300	679	3,074	528	107	...
United States	1,193	2,542	529	225	...	2,608	333	650	269	2,093	...
Italy	3	60	...	...	..	.	...	...	...	...	...
Total, £	6,290	30,531	8,087	15,058	1,777	47,353	1,947	9,549	24,209	2,200	...

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

	£	£	£	£	£	£	£	£	£	£	£
Various countries, mainly as above	2,279	1,280	957	478	...	1,688	...	4	6,651	376	...

Total Exports: £161,520

Total Re-Exports: £13,713

Total Imports: £147,001

Note.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

* This section does not include telegraph cables and apparatus.

STATIC BALANCERS.

By CHARLES C. GARRARD, Ph.D., A.M.I.E.E. A.Am.I.E.E.

(*Concluded from page* 987.)

Fig. 10 shows the variation of magnetising current under similar conditions, as in fig. 9.

(*d.*) *Influence of the dimensions of the core on the amount of magnetisation due to out-of-balance continuous current.*—Let H^1 be the magnetic force inside the winding due to the continuous current, if there were no iron present.

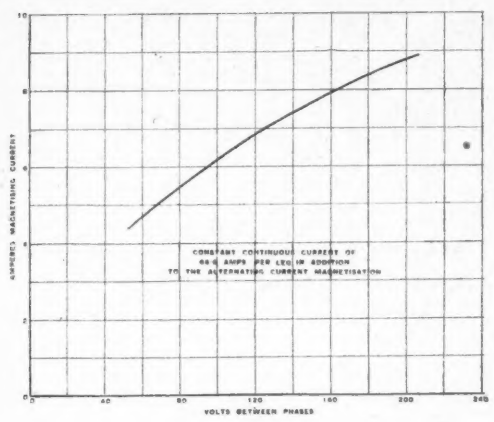
AMPERES MAGNETISING CURRENT
CONSTANT CONTINUOUS CURRENT OF
AMPS PER LEG IN ADDITION
TO THE ALTERNATING CURRENT MAGNETISATION
VOLTS BETWEEN PHASES

FIG. 10.

Let H be the magnetic force inside the coil (and inside the iron core), after the iron has been introduced inside the coil.

Let K and μ be the susceptibility and permeability of the iron.

Let B be the magnetic induction per square centimetre due to the continuous current.

For ease of calculation we assume the core to be shaped like an ellipsoid of revolution of length $2c$ and thickness $2a$. We have then—

$H = H^1 - N I$, where N is a constant and I is the intensity of magnetisation (see Ewing, "Magnetic Induction in Iron, &c.," page 24).

$$\therefore \frac{H^1}{H} = 1 + \frac{N I}{H} = 1 + N k,$$

$$\therefore \frac{H}{H^1} = \frac{1}{1 + N k}.$$

Now, if $\frac{c}{a} = 2$, then $N = 2{\cdot}3$;

and if $\frac{c}{a} = 3$, then $N = 1{\cdot}35$ (Ewing).

From these two values of N we are able to calculate the resultant B with the two differently shaped cores.

Let us assume that the original H (without iron) was 150.

Longer Core.	Shorter Core.
Taking $K = 120$, we get	Taking $K = 80$, we get
$H = \frac{H^1}{1 + 1{\cdot}35 \times 120} = \frac{H^1}{163}$	$H = \frac{H^1}{1 + 2{\cdot}3 \times 80} = \frac{H^1}{183}$
If $K = 120$, then $\mu = 1{,}500$,	If $K = 80$, then $\mu = 1{,}000$,
$\therefore B = \frac{1{,}500 \times 150}{163} = 1{,}400.$	$\therefore B = \frac{1{,}000 \times 150}{183} = 820.$

It will be seen that the shorter core has the smaller magnetic flux, although the number of magnetising ampere-turns per centimetre length of the core is the same in each case. Of course, the above calculation is only qualitative, but it clearly indicates that a squat design is best, *i.e.*, the core is to be kept as short as possible. This is the opposite to a good design of a core-type static transformer.

5. *System of Balancing in which the mid-wire of the three-wire network is connected to Star Point of the Low Tension Windings of the Transformers feeding the Rotary Converter.*—As stated at the beginning of this article, this system has been applied in practice, and the balancing results therefrom have been highly satisfactory. In theory, of course, this system is exactly the same as that of the static balancer, and it might be thought that where rotaries are concerned the use of a special balancer would not be warranted. This, however, does not follow, and where any considerable amount of out-of-balance current is required to be dealt with, it is highly probable that a special balancer connected to the slip-rings of the rotary will be cheaper and more efficient than using the star point of the main transformers.

We have seen above that a squat design is most suitable for a static balancer. This, however, is just the opposite to a transformer, which is generally desired to have as little reactance as possible (of course, if the transformers are specially designed with a large reactance to render possible variation of voltage in the rotary, the conditions are modified somewhat, but not sufficiently to alter the main point of the proposition). In the lay-out of a station now a days, we may take it that transformers of standard design will be used. The number of turns in the transformer will be most probably considerably more than in the case of a specially designed balancer, which would of itself diminish the efficiency of the system. The increase of iron loss is, however, the really serious matter. The amount and proportions of the iron in the transformers being fixed from the transformer point of view, the increase of iron loss due to the out-of-balance current would be much greater than if a special balancer were used, so that the overall efficiency of the plant would be lowered, and the temperature rise of the transformers would be excessive. These considerations would generally more than counterbalance the cost of a special balancer whenever there is any considerable amount of out-of-balance current to be dealt with. The balancer can be constructed having sole regard for its special object, and the efficiency of the same can be made a maximum. It must not be forgotten that a static balancer, capable of dealing with an out-of-balance current of 200 amperes on a 480-volt three-wire system, is only quite a small affair, corresponding to a 34-KW. three-phase transformer with half the copper removed. If the out-of-balance current were 10 per cent. this would be on a system of 960 KW., necessitating a 1,000-KW. transformer (or three of 333 KW. each) to feed the rotary. The provision of this small balancer would result in the out-of-balance current getting back into the rotary with but the relatively small losses in the balancer, whereas, to pass the out-of-balance direct current through the 1,000-KW. main transformer would result in much larger losses.

To take a concrete example, the total iron and copper losses in a balancer of this size might amount to about 700 watts. From the curves given in figs. 8 and 9, it will

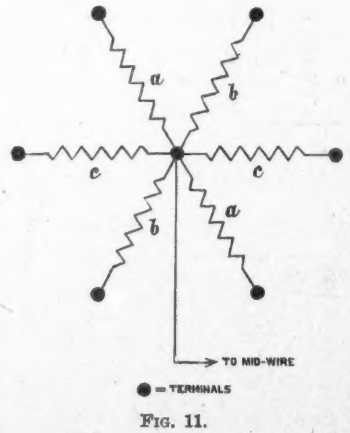

FIG. 11.

be seen that we can safely assume that the iron losses in the transformers would be doubled by the passage of the continuous current through the windings. The extra copper loss in the windings of the transformers can be neglected, as these will be of very thick wire. The iron loss of a 1,000-KW. transformer would be of the order of 6,000 watts. Doubling this means an extra loss of 6,000 watts, against 700 watts in the balancer. Thus, from the efficiency point

of view, the advantage is nearly 10 to 1 in favour of the balancer. Assuming that the out-of-balance current were on for an average of six hours daily, in the course of a year the extra loss, at ½d. per unit, amounts to £24 8s. Thus the balancer would pay for itself in about two years. From every point of view, therefore, the balancer is the more economical arrangement.

6. *Six-phase Construction of Static Balancers.*—A six-phase winding of a balancer is shown in fig. 11.

The core used is an ordinary three-phase one, each leg having two windings *a a*, *b b* and *c c*. If V be the D.C. voltage of the generator, then the voltage between slip-rings will be ·354 V and the voltage from one terminal to the neutral point will be ·354 V.

The advantages of the six-phase construction are :—

1. Complete neutralisation of the continuous-current magnetisation is readily possible without any extra windings for this purpose. Thus the balancer can have minimum iron loss.

2. The balancing is much better than with either the three-phase or the single-phase machine (see paragraph 3 *a*).

It can be readily believed that in many cases these two advantages will outweigh the expense of putting the extra slip-rings on the dynamo.

7. *Method of Testing Static Balancers.*—As, in order to get at the true losses in a balancer, it is necessary to test it under working conditions, arrangements have to be made to pass both continuous and alternating current through it at the same time. This can be done most conveniently in the test room by using two balancers connected according to the diagram of connections given in fig. 12.

D is a source of direct current, either a dynamo or battery, and the amount of direct current is regulated by the resistance R, and measured by the (moving-coil) ammeter A_2. A_1 is an alternating-current (soft-iron) ammeter for measuring the magnetising current. W_1 and W_2 are wattmeters for measuring the iron loss. Correction of the readings of W_1 and W_2 can be made for the small copper loss in the windings due to the passage of the magnetising current. This, however, will be but small. The readings of A_1, W_1 and W_2 have to be halved to give the readings corresponding to the single balancer.

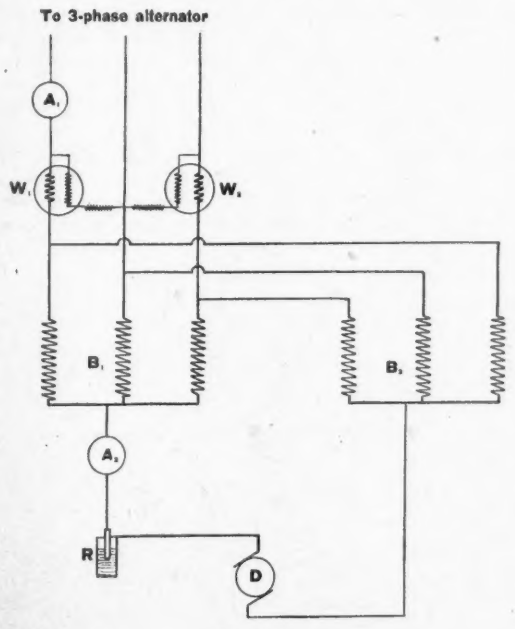

FIG. 12.

8. *Cause of Increased Iron Loss in Transformers and Balancers due to Passage of Continuous Current through their Windings.*—The large increase of iron loss which, as is shown in paragraph No. 4*c*, accompanies the passage of continuous current through the windings of the apparatus is, at first sight, rather surprising. As regards the loss in the laminated core itself, this is made up of two components :—

1. Eddy-current losses.
2. Hysteresis loss.

As regards (1) it is clear that the eddy-current loss in the core will not be changed, as its value simply depends on the variation of the magnetic flux. This variation is the same whether there be continuous-current magnetisation or not. Concerning the hysteresis loss, it is possible to get some idea of this from studying the variation in the area of the B-H curve for like variations of B but at different mean values of B.

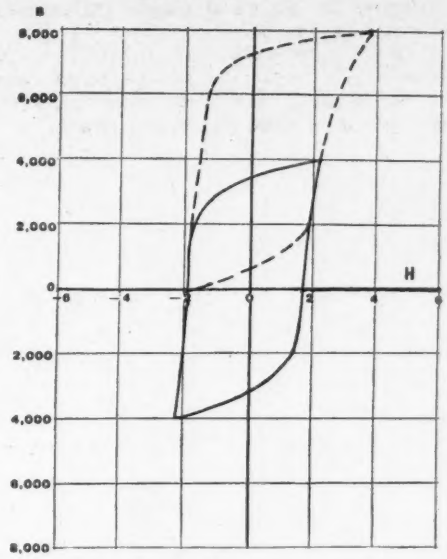

FIG. 13.

The curves in fig. 13 are copied from those given in page 95 of Ewing's "Magnetic Induction in Iron and other Metals." The curves are for a very sott iron ring, and are near enough to transformer iron for this purpose. Consider, first, an alternating magnetising force only applied, corresponding to a maximum induction of 4,000. The hysteresis loss is proportional to the area of the full lined curve. If now we let the iron be magnetised by a continuous magnetising force to a value of B = 4,000 and then apply an alternating magnetisation corresponding to the same total variation of induction as before, viz., 8,000, we get the iron loss as proportional to the area of the dotted curve. On comparing the area of the dotted with that of the full lined curve, it appears that the former is only a slight percentage larger than the latter. This consideration would tend to show that the extra iron loss found to accompany the passage of continuous current through the windings is not so much in the iron of the core itself, but has its seat outside the core, and is really the result of iron losses set up in the iron tank by the magnetic leakage due to the un-neutralised continuous-current magnetisation. If this latter explanation be correct, however, the propositions set forth in this article would not be affected, as all balancers, transformers, &c., have to be, of necessity, enclosed in some kind of tank. The main fact is that the losses are bound to occur if the precautions mentioned above are not taken.

CENTRAL-BATTERY TELEGRAPHS.

LIKE the closed-circuit system still in use in America, a central-battery system possesses the feature that one or more stations can transmit signals by means of a battery located at another station on the same circuit.

On account chiefly of the difficulty and high cost of maintaining primary batteries delivering a continuous current, the closed-circuit system was abandoned in this country many years ago; but the application of secondary cells to

telegraphic purposes has so altered the conditions, as to lead to the utilisation of such cells for the central-battery working of telegraphs.

As this system of working is being rapidly extended by the British Post Office, and is receiving attention elsewhere, a brief description of the Post Office arrangements will be of interest.

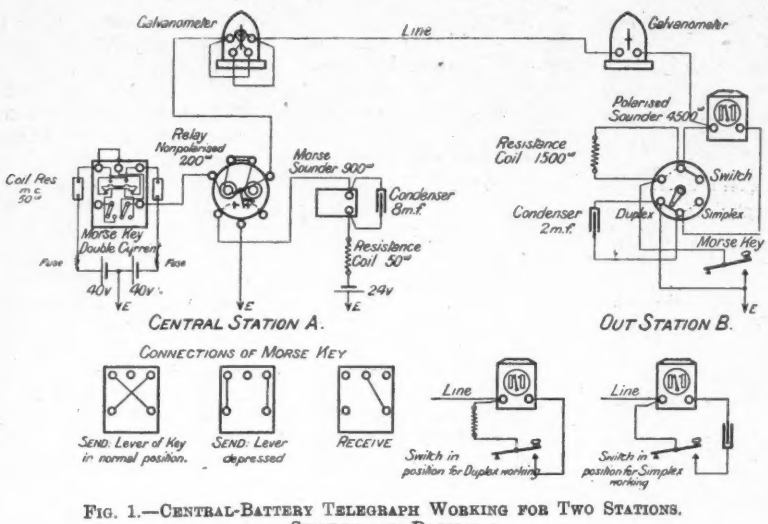

FIG. 1.—CENTRAL-BATTERY TELEGRAPH WORKING FOR TWO STATIONS. SIMPLEX AND DUPLEX.

C. B. DUPLEX.

Central-battery working has been applied to duplex as well as to omnibus circuits. For ordinary duplex, whether "bridge" or "differential," the line resistance has to be balanced at both stations by means of a rheostat, the balancing resistance upon open lines varying with the insulation; but the central-battery duplex dispenses with balancing resistances, no adjustment being needed—an obvious advantage at small offices, where the operators generally have very little technical knowledge.

The normal current from the central station A, fig. 1, passes to line through the coils of a non-polarised relay, but is not of sufficient strength to overcome the pull of the antagonistic spring upon the armature. At the out-station, the current passes through a polarised sounder (to be described later), the coils of which have a resistance of 4,500 ohms. A depression of the Morse key at A, by reversing the battery, actuates the polarised sounder at B, but the relay at A, being non-polarised, will remain unaffected.

The depression of the Morse key at B shunts with a resistance of 1,500 ohms the polarised sounder, the result being that the current from the battery at A is increased sufficiently to actuate the relay, and the signal from B is reproduced by means of a local current actuating the sounder at A. The sounder is shunted by a condenser of 8 microfarads, whose discharge counteracts any tendency to splitting of signals due to reversals of the battery by the key at A while the key at B is being worked.

The 1,500-ohm shunt at B takes approximately the excess current resulting from its addition to the circuit, the signals from A through the polarised sounder at B remaining therefore unaffected by the manipulation of the key at B.

Briefly, duplex working is effected by utilising reversals of current for signals in one direction and increments of current for signals in the opposite direction.

To prevent waste of current a switch is fitted at B, enabling a condenser to be inserted in the receiving portion of the circuit when duplex is not required. This switch also short-circuits the 1,500 coil, and thus, by bringing the connections into line with those of the central-battery omnibus arrangement (about to be described), enables duplex circuits to be placed on a concentrator switch and to be worked from sets interchangeably with omnibus circuits.

C. B. OMNIBUS WORKING.

In central-battery working for omnibus telegraph circuits the battery is connected to the line through a resistance of 3,000 ohms. The central and out-stations are leaked off the main circuit, a condenser being inserted with the polarised sounder in the receiving circuit at each station, fig. 2.

The action of the condenser when an out-station is signalling differs somewhat from that of the condenser in the duplex arrangement already described, as well as from that of the "reading" condenser on Wheatstone circuits, inasmuch as a reversal of impulse is obtained without any actual reversal of the signalling battery.

All condensers on an omnibus circuit of this type are normally charged; an out-station signals by earthing the circuit, thus allowing all the condensers on the circuit to discharge to earth through the polarised sounder at each point. The striker of the polarised sounder is thus carried against the "marking" plate and a signal is received.

On the sending key rising, the condensers take up a charge,

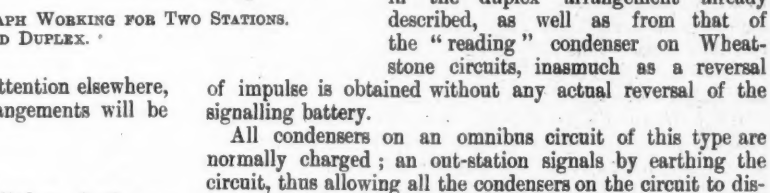

FIG. 2.—CENTRAL-BATTERY WORKING FOR OMNIBUS TELEGRAPH CIRCUITS.

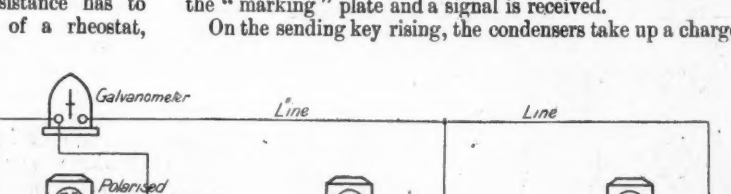

FIG. 3.—POLARISED SOUNDER B.

and the strikers return to the "spacing" plate. The polarised sounder must, of course, be adjusted to a neutral position.

The utilisation of both the charge and the discharge enables a double-current effect to be obtained without a reversal of the battery.

At each out-station the connections are such that outgoing signals are reproduced on the polarised sounder at that station, thus providing the operator with an indication that the line is intact and rendering a galvanometer unnecessary. To minimise noise at the larger offices, the polarised sounder at the central station is cut out when that station is sending, a galvanometer being inserted to indicate that the impulses are duly passing to line.

Central-battery working renders possible large economies in first cost and in maintenance. Less apparatus is required, and in the case of intermediate stations, to which, for ordinary working, a loop is required, there is a saving in wire. Battery maintenance is also considerably reduced, especially in outlying country districts; and there is also economy in instrument maintenance, owing to the simplification of apparatus, and the abolition of relays. Incidentally, the system overcomes the difficulty met with at many small offices, of a want of space for the accommodation of batteries.

There is a limit to the application of central-battery working on aerial lines owing to loss of insulation in wet weather, but working is reliable in this country up to a distance of 60 miles. An abnormal loss of insulation can sometimes be compensated for by an increase in the voltage of the central battery.

The Polarised Sounder.

The receiving instrument used in the Metropolitan intercommunication system (described in our issues of May 17th and 24th last), namely, the polarised sounder, is also employed in the C.B. systems now described. It consists essentially of a horseshoe electromagnet (the soft-iron cores of which are magnetised by induction from a permanent magnet) and a pivoted armature, to the spindle of which is attached a hammer or striker playing between two metal sounding pieces, fig. 3.

The north pole of the permanent magnet is screwed to the centre of the yoke, the south pole being in close proximity to the centre of the armature. In the middle, or neutral, position of the armature the induced magnetism of one core is neutralised by that of the other, but both ends of the armature are of south polarity by induction from the permanent magnet.

A current in the coils increases the magnetism of one pole of the electromagnet and decreases, neutralises, or reverses that of the other. "Bias" can be obtained by bringing one end of the armature nearer than the other to the cores.

The spindle upon which the armature is pivoted projects through the dial, and carries in front of it a vertical striker of hard brass, whose movement is limited by metal pins attached to sounding pieces, these pins limiting also the movement of the armature.

In order that the sounds emitted may differ in character, the right-hand sounding piece receiving the "marking" stroke is made 20 mils thick and is split lengthwise in front, while the left-hand piece receiving the "spacing" stroke is 30 mils thick and is not split.

Thus made, the marking stroke is a little louder and more resonant than the spacing, and the risk of the operator reading the signals reversed is avoided.

The coils have a resistance of 5,400 ohms, shunted by a resistance of 27,000 ohms, making a joint resistance of 4,500 ohms.

The range of current with which the polarised sounder will work is a very wide one. The figure of merit is 1 milliampere, the working current generally allowed being about 6 milliamperes, but the instruments will work well with any current between the limits of 2 and 20 milliamperes without any alteration in the neutral adjustment, the volume of sound emitted being the only variation observed.

Another form of polarised sounder recently introduced by the Post Office is, at large offices, to displace the form shown in fig. 3. The newer sounder is of the well-known "pony" type, regarding which the only observations that need here be made, are that the yoke of the electromagnet is removed, that a permanent horseshoe magnet is placed under the cores so as to polarise them, and that the coils are wound and shunted so as to have a joint resistance of 4,500 ohms, as in the case of the other type.

It may be added that for ordinary duplex working a further and more recent development of the pony form of polarised sounder consists in the winding of the coils differentially to a resistance of 5,000 ohms, so that the sounder can be placed in the direct circuit on long lines, thus obviating the necessity for a relay and local circuit.

BROWN-BOVERI STEAM TURBINES IN THE RHENANIAN-WESTPHALIAN INDUSTRIAL DISTRICT.

By Dr. ALFRED GRADENWITZ.

The numerous steam turbine plants recently installed in the industrial district of Rhenania and Westphalia, strikingly illustrate the advantages afforded by turbines over reciprocating steam engines and other power producers. While most of the mining plants and metallurgical works of that part of the country have adopted steam turbines extensively

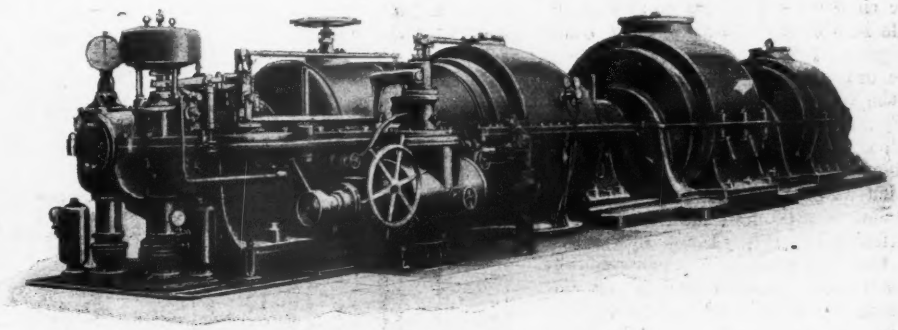

Fig. 1.—Brown-Boveri-Parsons 10,000-h.p. a.c.-d.c. Turbo-Generator at the Rhenanian-Westphalian Electricity Works, Essen.

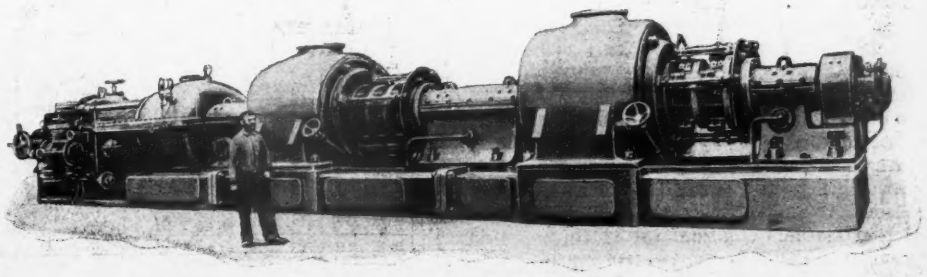

Fig. 2.—Tandem d.c. Turbo-Generator of 1,250 h.p. at Crefeld Electricity Works.

not only as prime movers for their electric generators, but also for the driving of centrifugal pumps and compressors,

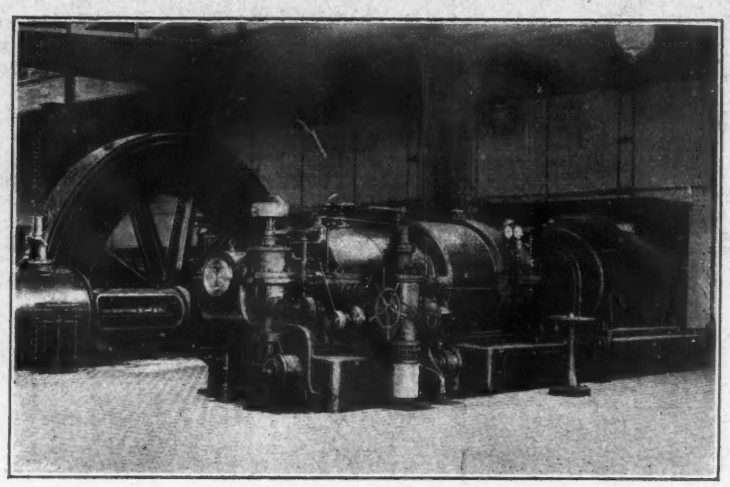

FIG. 3.—BROWN-BOVERI-PARSONS 2,250-H.P. TURBO-ALTERNATOR AT DORTMUND ELECTRICITY WORKS.

the numerous electricity works of the district during the last few years have also given the steam turbine a marked preference over other types of prime mover.

One of the more typical of these plants is the Rhenanian-Westphalian Electricity Works, at Essen, which supplies a number of communities and industrial works with electrical energy for both lighting and power purposes.

This plant comprises a vertical steam engine with a 3,000-H.P. generator coupled directly to it, in addition to two similar sets of 1,000 H.P. each, and two of 600 H.P.

The first turbine set, a Brown, Boveri-Parsons unit, was installed in 1905; the steam turbine, with an output of 10,000 H.P. and a speed of 1,000 R.P.M., is directly coupled to an A.C. generator of 5,000 KW. and 50 cycles, and a D.C. generator for 1,500 KW. at a pressure of 600 volts.

A similar set was installed at the end of the same year, while in view of the satisfactory results given by these two plants, four other turbo-generators of 5,000 KW. each were ordered, in addition to another unit of the same size for the Wiendahlsbank mines.

Fig. 1, p. 1063, represents one of the 10,000-H.P. sets.

The aggregate output of the steam-turbine plant installed at this central station will be 50,000 H.P. after the installation of the four additional sets.

After being stepped up by means of transformers to a pressure of 10,000 volts, the electrical energy generated is distributed to the various centres of consumption. The distribution switch-panels are equipped with hand-wheels operating from a distance the high-tension oil switches, and with ammeters and time relays fixed in projecting glass cases. These relays, in the place of fuses, automatically interrupt the circuit by operating the high-tension oil switches. Above the switchboard are situated the bus-bars, the bus-sectioning switches being controlled from a gallery.

Another typical plant in the same district, in which Brown-Boveri-Parsons steam turbines have been adopted as an addition to existing steam engines, is the Municipal Electricity Works of the city of Dortmund. The first turbo-generator set of that station was put into operation in February, 1905. The turbine, of 2,250 H.P., is directly connected to an alternator of 2,600 to 2,900 volts pressure, at 50 cycles, with a speed of 1,500 R.P.M. Owing to the satisfactory results obtained in operation, two further turbo-generators of 3,600 H.P. output were ordered successively for this electricity works. Fig. 3 shows the central station after the inauguration of the first unit.

A turbo-tandem set of 1,250 H.P. shown in fig. 2 is installed at the municipal electricity works of the city of Crefeld.

The turbine of this set is directly coupled to two continuous-current generators having outputs of 500 and 375 KW. respectively, constructed by Messrs. Brown, Boveri & Co. These two generators supply current at 600 volts pressure.

Finally fig. 4 shows the steam turbine test beds at the Mannheim works of Messrs. Brown, Boveri and Co. After being erected complete with the electric generator, each turbine is tested on a water resistance. The steam pressure, superheat and degree of vacuum are accurately adjusted in accordance with the conditions anticipated for practical operation. The boiler and condensing plant, measuring apparatus and water resistance of this test bed will take a 4,000-H.P. steam turbine under full load.

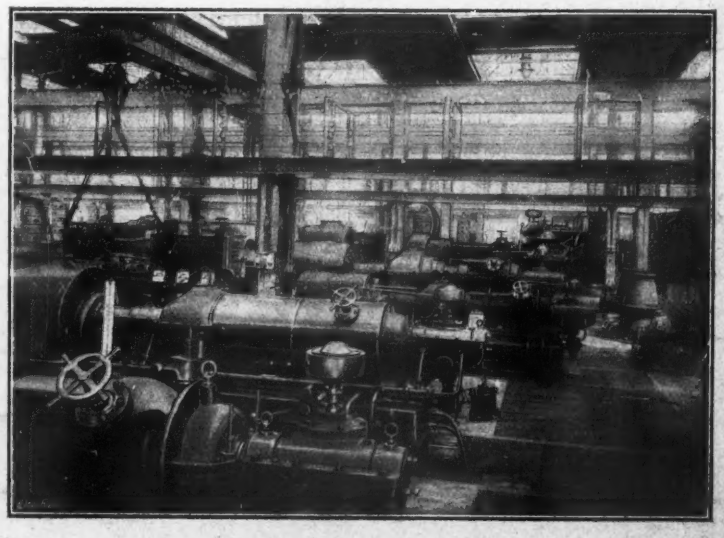

FIG. 4.—TURBINE TEST BED AT MESSRS. BROWN, BOVERI'S WORKS, MANNHEIM.

ADEQUATE DEPRECIATION OF CAPITAL EXPENDITURE BY MUNICIPAL ELECTRICITY UNDERTAKINGS.

BY J. HORACE BOWDEN, Borough Electrical Engineer and Manager, and
FRED TAIT, Managerial Assistant, Metropolitan Borough of Poplar.

(*Concluded from page* 1023.)

THE greatest essential in any system of accounts is a perfectly accurate method of cost keeping, whereby the prime cost of any item of capital expenditure is made of easy reference. No detail should be ignored in describing the nature of the work executed, and, where possible, reference should be made to the Drawing No. in which the particular work is set out.

For the purpose of keeping cost records of capital expenditure, the loose-leaf ledger system is recommended, electricity undertaking, not with the view of holding up this particular example as a model undertaking, but in order to

Statement of Capital Expenditure and Adequate Depreciation.

Years working.	Stages.	Theoretical provision for sinking fund.	Pr'ctical pr'visi'n for sinking fund.	Interest on outstanding capital at 3¾%.	Requisite gross profit to meet sink'g f'nd & interest.	Actual gross profit by Poplar.	Actual provision made for s'k'g f'nd by Poplar.	Actual int. on loans by Poplar.	Surplus in hand, Poplar.	kw. capacity plant installed Poplar.	Maximum load demanded, Poplar.	Reserve plant kw., Poplar.	Output B.T.U. sold, Poplar.	Load factor per cent., Poplar.	Average price obtained.	Total cost per B.T.U. sold.	Gross profit required.	Units per capitum per annum.
		£	£	£	£	£	£	£	£						d.	d.		
1	1st stage	3,175	—	3,075	3,075	3,842	35	3,252	—	600	536	64	767,185	16·34	3·269	2·067	—	4·5
2	1st stage	6,250	—	5,662	5,662	9,534	168	5,082	3,908	1,600	912	688	1,787,547	22·37	2·709	1·430	—	10·6
3	1st stage	7,250	—	6,488	6,488	9,689	803	5,901	6,893	1,600	1,224	376	2,206,397	20·52	2·423	1·370	—	13·1
4	2nd stage	7,600	3,800	6,675	10,475	8,276	4,931	6,824	3,675	3,400	1,117	2,283	2,331,827	23·83	2·132	1·280	—	13·8
5	2nd stage	10,100	5,050	8,839	13,889	13,053	6,824	7,968	1,937	3,400	1,520	1,880	3,041,100	22·84	2·023	·992	—	18·0
6	2nd stage	10,500	5,250	9,231	14,481	14,597	5,765	8,418	2,311	3,400	1,980	1,420	4,208,302	24·26	1·745	·912	—	25·0
						Estimated					Estimated.							
7	3rd stage	10,515	10,515	9,236	19,751	17,873	6,250	8,500	5,311	3,400	2,400	1,000	5,000,000	23·78	1·654	·799	·855	30·0
8	3rd stage	10,955	10,955	9,209	20,164	—	—	—	—	3,400	2,800	600	6,000,000	24·46	1·393	*·587	·806	35·5
9	3rd stage	11,330	11,330	9,179	20,509	—	—	—	—	4,200	3,200	1,000	7,000,000	24·91	1·263	·560	·703	41·3
10	3rd stage	11,525	11,525	9,150	20,675	—	—	—	—	4,200	3,600	600	8,000,000	25·37	1·160	·540	·620	47·5
11	3rd stage	11,850	11,850	9,361	21,211	—	—	—	—	—	4,000	—	8,750,000	25	1·111	·529	·582	51·9
12	3rd stage	12,220	12,220	9,342	21,562	—	—	—	—	—	4,400	—	9,650,000	25	1·052	·516	·536	57·2
13	3rd stage	12,675	12,675	9,305	21,980	—	—	—	—	—	4,800	—	10,500,000	25	1·009	·507	·502	62·2
14	4th stage	13,160	17,560	9,113	26,673	—	—	—	—	—	5,200	—	11,375,000	25	1·061	·498	·563	67·4
15	4th stage	13,615	18,015	8,938	26,953	—	—	—	—	—	5,600	—	12,250,000	25	1·019	·491	·528	73·2
16	4th stage	14,110	18,510	8,764	27,274	—	—	—	—	—	6,000	—	13,150,000	25	·982	·485	·497	78·5
17	4th stage	14,730	19,130	8,584	27,714	—	—	—	—	—	6,400	—	14,000,000	25	·955	·480	·475	83·0
18	4th stage	15,340	19,740	8,405	28,145	—	—	—	—	—	6,800	—	14,900,000	25	·928	·475	·453	88·2
19	4th stage	15,945	20,345	8,232	28,577	—	—	—	—	—	7,200	—	15,750,000	25	·907	·471	·436	93·3
20	4th stage	16,585	20,960	8,232	29,192	—	—	—	—	—	7,600	—	16,650,000	25	·888	·469	·421	98·6
—	—	229,430	229,430	165,020	394,450	—	—	—	—	—	—	—	—	—	—	—	—	—

* Running costs estimated at ·4d., and standing charges, £8,000.

sub-divided into the Board of Trade allocations. Schedules of each year's capital expenditure, under the various allocations, should be inserted, and provision made for entering annual depreciation at the agreed standard rate, so that each year the aggregate sum of depreciation so entered will be in accordance with the amount debited to sinking fund account. A form upon the following lines will be found sufficient :—

Capital Station Machinery—20 Years' Life.

Year ending.	Description.	Drawing number.	Job number.	Prime cost folio.	Prime cost.	March 31st, 1908. Depreciation.	March 31st, 1908. Capital value.

The number of rulings would be dependent upon the standard life of the asset. The Drawing No. reference will be found of value, the Job No. will refer to the works order fully descriptive of the nature of the work, and the Prime Cost Folio reference will give access to every fraction of the cost.

A column should be allowed after "years of life" for residual values, and also debit and credit columns for balances carried to reserve fund. In the event of supersession or antiquation before the expiry of the standard life, the balance would probably be a debit one; but should the plant be found in useful operation at this period, then a valuation should be made, the amount credited to reserve and debited to capital account, and again depreciated at a re-assessed life.

In preparing the accompanying statement of capital expenditure and adequate depreciation, the writers have dealt with, approximately, the capital expended on the Borough of Poplar

Wages	£2,100	Coal	·3d.
Rates, &c.	2,200	Water and stores ...	·01d.
Salaries	2,500	Maintenance ...	·045d.
Printing and stationery ...	100	Distribution ...	·045d.
Central establishment ...	200		
General do. ...	500		
Bad debts and allowances ...	150		
Law and compensation ...	150		
Insurance	100		
	£8,000		·400d.

be practical, as far as possible, in their financial propositions.

The expenditure to the end of the six years of working may be taken as actual, and onwards to the end of the 20 years period, the figures are hypothetical.

From the foregoing statement, it is obvious that if provision were made as per the depreciation table the policy of the undertaking as regards future capital expenditure is quite clear, provided the scope of the undertaking is not enlarged by the addition of traction supply, free wiring, hiring out motors, arc lamps, &c., but should any of these additions be made, the principles of depreciation as set forth would be merely extended, and the capital limit raised.

However, as stated in the first portion of this article, it is impracticable to make adequate depreciation during the

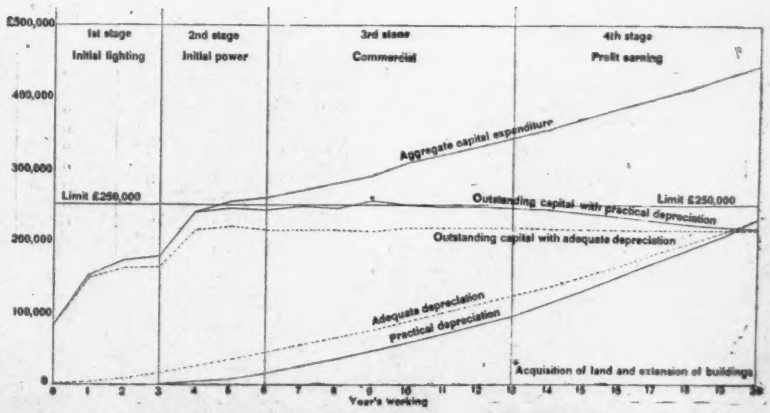

Diagram of Capital Expenditure and Depreciation.

CAPITAL EXPENDITURE. Limit, £250,000

—	—	—	1st year.	2nd year.	3rd year.	4th year.	5th year.	6th year.	7th year.	8th year.	9th year.	10th year.	11th year.	12th year.	13th year.	14th year.	15th year.	16th year.	17th year.	18th year.	19th year.	20th year.
		£	£	£	£	£	£	£	£	£	£	£	£	£	£	£	£	£	£	£	£	£
Land	I	3,000	—	—	—	1,500	—	—	—	—	—	3,000	—	—	—	—	—	—	—	—	—	—
Buildings, permant.	II	15,000	—	—	—	6,000	3,000	—	—	—	—	3,000	—	—	—	—	—	—	—	—	—	—
,, tempry.	IIA	6,000	2,000	2,000	—	2,000	1,000	100	400	400	400	500	500	500	600	600	700	700	700	800	600	800
Machinery	III	18,000	25,000	10,000	2,000	25,000	4,000	3,000	4,600	4,600	5,000	5,000	5,500	5,500	6,000	6,000	6,500	7,000	7,000	7,500	8,000	8,500
Mains	IV	36,000	3 ,000	9,000	1,500	12,000	6,000	1,800	2,100	2,100	2,100	2,100	2,100	2,400	2,400	2,400	2,700	2,700	3,000	3,000	3,300	3 300
,, ducts	IVA	—	—	—	—	12,000	—	—	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800
Meters..	V	1,500	1,000	500	500	250	250	250	400	500	500	500	600	600	700	700	700	700	800	800	800	900
Insts. tools & off. ftre.		750	550	400	500	250	250	150	200	250	250	250	250	250	250	250	250	250	250	250	250	250
Prelim. and extra.	VI	500	200	100	—	1,000	1,000	100	300	500	500	1,000	600	600	600	700	700	700	800	800	800	900
Accumulators ..	VII	1,250	1,250	—	500	1,500	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
		82,000	69,000	22,000	5,000	61,500	15,500	5,400	9,800	10,150	10,550	17,150	11,350	11,650	12,250	12,450	13,350	13,850	14,350	14,950	15,750	16,450
Aggregate capital ..	..	82,000	151,000	173,000	178,000	239,500	255,000	260,400	270,200	280,350	290,900	308,050	319,400	331,050	343,300	355,750	369,100	382,950	397,300	412,250	428,000	444,450

DEPRECIATION.

	Yrs.		£	£	£	£	£	£	£	£	£	£	£	£	£	£	£	£	£	£	£	£
Buildings, permnt...	60	—	250	250	250	250	350	400	400	400	400	400	450	450	450	450	450	450	450	450	450	450
,, tempry.	20	—	300	400	500	500	600	650	656	675	695	715	740	765	790	820	850	885	920	955	99(	1,035
Machinery	20	—	900	2,150	2,650	2,750	4,000	4,200	4,350	4,580	4,810	5,060	5,310	5,585	5,860	6,160	6,460	6,785	7,135	7,485	7,86(	8,260
Mains	30	—	1,200	2,500	2,800	2,850	3,250	3,450	3,510	3,580	3,650	3,720	3,790	3,860	3,940	4,020	4,100	4,190	4,280	4,380	4,480	4,590
,, ducts	60	—	—	—	—	—	200	200	200	230	260	290	320	350	380	410	440	470	500	530	56(	590
Meters..	10	—	150	250	300	350	375	400	425	468	515	565	465	425	435	445	490	535	58(	6:0	65(	680
Insts., tools & off. ftre.	10	—	75	130	170	220	245	270	285	305	330	355	305	275	260	295	235	235	245	250	25(	250
Prelim. and extra ..	10	—	50	70	80	80	180	280	290	320	370	420	470	510	560	620	590	560	64(	670	70(	780
Accumulators ..	5	—	250	500	500	600	900	650	400	400	300	—	—	—	—	—	—	—	—	—	—	—
		—	3,175	6,250	7,250	7,600	10,100	10,500	10,515	10,955	11,380	11,525	11,860	12,220	12,675	13,160	13,615	14,110	14,730	15 340	15,945	16,585
Outstanding capital	..	82,000	147,825	168,575	171,325	215,225	220,625	215,525	214,810	214,005	213,225	218,850	218,350	217,780	217,355	216,645	216,380	216,120	215,740	215,3(0	215,255	215,5(0
Per cent. to ,,	..	—	3·87	4·23	4·43	4·71	4·70	4·76	4·90	5·1	5 30	5·40	5·41	5·60	5·82	6·06	6·29	6·52	6·82	7·11	7·41	7·70

initial stages of the progress of any undertaking. In the accompanying table and diagram, the actual results of the first stages are set out together with an estimate of the remaining results during the years next following to complete the period of 20 years, the limit claimed as necessary to make adequate provision. The effect upon the standing charges is also given, showing that by the working policy set forth, it is possible to indicate an *average* charge per unit sold of under ·9d. The process of reaching this figure is necessarily slow, as it is accomplished by an evolutionary method. It may appear optimistic to anticipate this result (considering the price of coal delivered in London) within 14 years from date, yet it is probable that by more revolutionary methods, an average of ¾d. per unit may be reached in a much shorter period, if the question of bulk supply is intelligently dealt with by the metropolitan authorities. Although it may appear a digression from the subject matter in hand, to advert to the question of bulk supply, yet adequate depreciation must largely enter into any scheme that may be put forward, a matter which has hitherto been palpably ignored.

The foregoing statements and statistics have been the subject of considerable study, and are claimed to be not haphazard, but the outcome of deliberations extending over an extended period. An endeavour has been made to walk beyond the fringe of the carpet; there may be points in connection with the system that have not been lucidly explained, or that may have escaped the writers' notice, for the subject is too far-reaching to be thoroughly dealt with in these columns; but if the engineers in this country, as a body, will give the question the consideration which it commands, it is possible that a definite system for adequate depreciation by local authorities may be arrived at.

Before concluding, there is one matter of importance to which reference must be made, *i.e.*, the present method adopted by the L.C.C. of granting loans on the annuity system. If this system is continued, the value of their new proposals to issue loans on the presumed life of the assets (to which, by the way, no one can object, providing the presumed lives are adequate) becomes useless, as adequate provision would not be made until the expiry of the loan. The adjoining table is a comparison between the effect upon the depreciation of £250,000 capital by redemption made on the instalment and annuity systems.

From this statement it will be seen that it is not until the 25th year that adequate depreciation is made in any one year, and up to that date the provision made is £47,100 less than should have been if depreciation had been computed on the presumed life of the assets.

A similar inadequacy occurs in the system set forth by an electricity financial expert in a recent paper read before the Institution of Electrical Engineers whereby he assumes a life of 25 years for machinery, apparatus, &c., costing, say, £100,000, which, if invested in the undertaking, would necessitate the provision of an annual sum of £4,000 for depreciation, but on the other hand, if invested in securities at 3 per cent., would only require the provision of an annual sum of £2,742 16s.

Instalment loans.			Annuity loans.		
Year.	Annual sum.	Provision to date.	Year.	Annual sum.	Provision to date.
	£	£		£	£
1	5,952	5,952	1	2,505	2,505
2	,,	11,904	2	2,600	5,105
3	,,	17,856	3	2,699	7,804
4	,,	23,808	4	2,802	10,606
5	,,	29,760	5	2,908	13,514
6	,,	35,712	6	3 019	16,533
7	,,	41,664	7	3,134	19,667
8	,,	47,616	8	3,253	22,920
9	,,	53,568	9	3,377	26,297
10	,,	59,520	10	3,505	29,802
11	,,	65,472	11	3,639	33,441
12	,,	71,424	12	3,777	37,218
13	,,	77,376	13	3,920	41,138
14	,,	83,328	14	4,069	45,207
15	,,	89,280	15	4,224	49,431
16	,,	95,282	16	4,385	53,816
17	,,	101,184	17	4,552	58.368
18	,,	107,136	18	4,725	63,093
19	,,	113,088	19	4,905	67,998
20	,,	119,040	20	5,091	73,089
21	,,	124,992	21	5,285	78,374
22	,,	130,944	22	5,486	83,960
23	,,	136,896	23	5,694	89,654
24	,,	142,848	24	5,911	95,565
25	,,	**148,800**	**25**	**6,135**	**101,700**
26	,,	154,752	26	6,369	108,069
27	5,953	160,705	27	6,611	114,680
28	,,	166,658	28	6,863	121,543
29	,,	172,611	29	7,123	128,666
30	,,	178,564	30	7,395	136,061
31	,,	184,517	31	7,676	143,737
32	,,	190,470	32	7,967	151,604
33	,,	196,423	33	8,271	159,875
34	,,	202,376	34	8,585	168,460
35	,,	208,329	35	8,911	177,371
36	,,	214,282	36	9,251	186,622
37	,,	220,235	37	9,602	196,224
38	,,	226,188	38	9,968	206,192
39	,,	232,141	39	10,347	216,539
40	,,	238,094	40	10,740	227,279
41	,,	244,047	41	11,149	238,428
42	,,	250,000	42	11,572	250,000

The following statement illustrates the difference between the two systems during the various stages of the life of the assets.

Invested in undertaking.			Invested in securities.		
Year.	Annual sum.	Provision to date.	Year.	Annual sum.	Provision to date.
	£	£		£	£
1	4,000	4,000	1	2,743	2,743
2	"	8,000	2	2,825	5,568
3	"	12,000	3	2,910	8,478
4	"	16,000	4	2,997	11,475
5	"	20,000	5	3,087	14,562
6	"	24,000	6	3,180	17,742
7	"	28,000	7	3,275	21,017
8	"	32,000	8	3,373	24,390
9	"	36,000	9	3,474	27,864
10	"	40,000	10	3,579	31,443
11	"	44,000	11	3,686	35,129
12	"	48,000	12	3,797	38,926
13	"	52 000	13	3,911	42,837
14	"	56,000	14	4,028	26,865
15	"	60,000	15	4,149	51,014
16	"	64,000	16	4,273	55,287
17	"	68,000	17	4,401	59,68[illegible]
18	"	72,000	18	4,534	64,222
19	"	76,000	19	4 670	68,892
20	"	80,000	20	4,809	73,701
21	"	84,000	21	4,954	78,655
22	"	88,000	22	5,102	83,757
23	"	92,000	23	5,255	89,012
24	"	96,000	24	5,413	94,425
25	"	100,000	25	5,575	100,000

From the above statement, it will be clearly seen that, in the event of a realisation of assets at the expiration of, say, 12 years, the depreciation fund in the second instance would be £9,000 less than it would have been if the first system had been followed out. The writers are certainly of the opinion that full provision should be made annually, whether invested in the undertaking or in securities, but if in the latter, the interest on the investments should be placed to credit of revenue account in order to meet the interest on further loans. If invested at a similar rate to the interest paid on loans, the second system would be placed on a similar basis to the first.

THE ROYAL SOCIETY CONVERSAZIONE.

At the second conversazione of the Royal Society on the 19th inst. there were very few exhibits that had not already made their appearance at the first conversazione.

Mr. A. A. Campbell Swinton demonstrated some interesting vacuum-tube phenomena, showing the effect of the positive or canal rays in turning small windmills mounted inside the tubes. The cathode in one of these tubes consisted of a disc with perforations through which the positive particles coming from the anode were projected and turned a windmill placed at the back of the disk. The positive or anode rays are known to consist of particles of atomic size, while the cathode rays consist of particles of much smaller size—the corpuscles or electrons. The impact of the positive particles is sufficient to turn the windmill, but rotation produced by the cathode rays is considered not to be due to direct impact, but to some indirect effect. Mr. Swinton also showed photo-micrographs of the bubbles that are developed by sudden heating of portions of the glass walls of Crookes tubes, owing to the expansion of residual gas occluded by the glass during prolonged use. In a special case shown under the microscope, the sudden heating had been occasioned by an electric spark, which thus impressed its image on the glass.

A fibre electroscope exhibited by Mr. C. E. S. Phillips had some interesting points of novelty. In this electroscope the gold leaf is replaced by a fibre of electrically-conductive glass which is delicately hinged so as to move very readily under the influence of a difference of potential. The fibre is hinged to its support by a tiny piece of gold leaf. The fibre is much superior as an index of deflection to the ordinary gold leaf, whose edges may be ragged, and which may be twisted. Much more precise readings of deflection can be obtained with the fibre.

Mr. Phillips also exhibited a new electroscope charger. The ease with which celluloid may be electrified by friction, together with its poor insulating property, are made use of in this apparatus. A celluloid rod is rubbed at one end by a flannel-lined split brass tube. The charge so produced spreads to the opposite extremity of the rod and is there utilized. Either a positive or a negative charge may be obtained from the same instrument.

The composition of Mr. Phillips's electrically-conductive glass is as follows: sodium silicate, 32 parts; boron, 8 parts; Powell's flint glass, 1·25 parts. The electrical conductivity is about 500 times as great as that of any other glass, and this material is suitable for the windows of electrostatic instruments as well as for supplying the fibres used in the fibre electroscope.

Mr. J. Mackenzie Davidson exhibited some stereoscopic X-ray photographs in a revolving lenticular stereoscope. The transparencies showed clearly the size and position of dense bodies such as particles of steel embedded in the eye.

LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names may be made. Answers are furnished by a barrister-at-law.*]

No. 92.—Escape of Electricity—Interference with Telegraphic System.

"A.B.C." writes:—"A railway company installs telegraphic apparatus, using in connection with the same an earth return, or the rails of its own track for return current. After some years a private industrial concern, having works adjacent to the railway company's line, installs electric plant for its own use. The leakage current therefrom seriously interferes with the working of the railway company's telegraphs. Has the railway company any remedy? It should be stated that the railway company has no protective clauses in its *own* Act or Acts."

*** The question propounded is very similar to that which arose some years ago in connection with the Cape Town Tramways. It was then found that electricity escaping from the tramway company's system interfered with the messages which were being transmitted along a submarine cable. The cable company sought to restrain the tramway company from allowing their current to escape and do damage. They based their claim upon the well-known principle of law, that where a man brings something on to his land which is dangerous and allows it to escape, he is answerable for the damage caused. That principle had been laid down in a case where a man had erected a reservoir on his land, and it was held that he was liable to his neighbours if water escaping from the reservoir injured their property. The Privy Council, however, refused to extend the principle of this case so as to give protection to persons who make use of minute currents of electricity which can easily be affected by induced currents. In the light of this decision, it is thought that the railway company in question has no remedy.

NEW PATENTS APPLIED FOR, 1907.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

13,385. "Means for teaching the direction of currents in electrical machinery and the method of operating such machinery." S. D. Cox. June 10th.

13,417. "Improved method of preventing the corrosion and decomposition of metals immersed in or in contact with water or other liquids due to electro-chemical action." P. E. G. Cumberland. June 10th. (Complete.)

13,432. "Improvements in fusible electric cut-outs." E. Schattner. June 10th.

13,437. "Electrical device for saving the services of a door attendant." F. H. Whysall and F. Jackson. June 10th.

13,449. "Improvements in or relating to magnetic circuits for static alternating current transformers and like induction devices." A. Gower and F. Hamer. June 11th.

13,534. "Measuring, rectifying and controlling apparatus for X-ray work." A. Friedrich. June 12th.

13,548. "Improvements in apparatus for measuring charges for electrical energy." J. S. Highfield.

13,563. "Method of and apparatus for fault location on electrical conductors." H. G. C. Fairweather. (H. M. Friendly, United States.) June 12th. (Complete.)

13,576. "Adjuncts and appliances for gas or electric pendants and pipes." S. Quincey and C. Harrison. June 12th.

13,577. "Improved high-tension cable." A. E. Tanner and E. A. Claremont. June 12th. (Complete.)

13,582. "Improvements in electrical resistances." W. F. Jones. June 12th.

13,596. "Improvements in or relating to wireless telegraphy." G. Jahr. June 12th.

13,617. "Improvements in apparatus for quick telegraphy." J. A. Grells. June 12th.

13,618. "Improvement relating to electrodes for search lights. Gebruder Siemens & Co. (Date applied for under Patents Act, 1901, July 30th, 1906, being date of application in Germany.) June 12th. (Complete.)

13,696. "Improvements in quick make and break electric apparatus for induction coils." Thomas-Bennett, Ltd., and J. H. Chambers. June 13th.

13,674. "Electrolytic ship-bottom protector." J. H. Schoneberger and G. W. Frazier. June 13th. (Complete.)

13,688. "Improvements relating to clockwork switches." F. T. Reid. June 13th.

13,712. "Improvements in and relating to dynamo-electric machinery." Hon. C. A. Parsons and A. H. Law. June 13th.

13,722. "Improvements in apparatus for producing high-frequency electric oscillations." G. Marconi and Marconi's Wireless Telegraph Co., Ltd. June 13th.

13,724. "Improvements relating to the electrical transmission of power." H. A. Mavor and Mavor & Coulson, Ltd. June 13th.

13,739. "Improvements in electric resistances and the like." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) June 13th.

13,760. "Improved method of automatic point control for electric tramways or the like." M. Rathborne, H. Fielding and A. P. Latham. June 14th.

13,761. "Novel or improved means for use in automatically regulating the voltage in connection with a dynamo-electric machine or machines." The Electric Construction Co., Ltd., W. Buchanan, and J. McMillian. June 14th.

13,786. "Improvements in means for use in controlling electric light circuits on railway vehicles and other electric circuits." F. A. Hewson. June 14th.

13,821. "Improvements in coin-controlled telephones." R. B. Jentzsch. June 14th.

13,838. "Improvements in and relating to protecting devices for alternating electric current distribution systems." British Thomson-Houston Co., Ltd., and J. E. Woodbridge. June 14th.

13,840. "Improvements in or relating to electro-mechanical automatic switches." M G. Waggott, M. Rosenburg, A. Lyne, S. Davies, E. Swindells, F. Moss, and H. Jackson. June 15th.

13,842. "Improvements in motor-generator control apparatus." A. F. Petch, F. Duncan and O. C. King. June 15th.

13,862. "Improvements in dynamo-electric machines." Bruce Peebles & Co., Ltd., and J. L. La Cour. June 15th.

13,875. "Improvements in and relating to electric transformers." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) June 15th.

13,891. "Apparatus for treating liquids electrolytically." A. O. Tate. June 15th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1906.

Dynamo-Electric Generators. W. A. Johnson. 6,838. March 21st.

Alternating Current Electric Motors. W. S. Franklin and S. S. Seyfert. 7,248. March 26th.

Electric Motor Control Systems. British Thomson-Houston Co. (General Electric Co.) 9,112. April 17th.

Electric Batteries. E. Buhot. 11,652. May 18th. (Date applied for under International Convention, May 23rd, 1905.)

Electrical Switches and Fusible Cut-Outs. F. Oprendek and S. Pollak. 11,667. May 18th.

Manufacture of Magnetic Material. R. A. Hadfield. 11,974. May 22nd.

Means for Igniting an Internal Combustion Engine. J. J. H. Sturmey. 12,175a. May 25th. (Date applied for under Rule 5, Patents Rules, 1905, May 25th, 1906).

Electric Glow Lamps. P. M. Justice (Deutsche Gasglühlicht Akt.-Ges. Auerges). 12,325 May 26th.

Electromotors. F. W. A. Young and H. T. Boothroyd. 12,304. May 26th.

Apparatus for the Electrical Production of Heat for Cooking and Other Purposes. A. F. Berry. 12,333. May 26th.

Electromagnetic Power Transmission. A. P. Zani. 12,340. May 26th.

Control of Dynamo-Electric Machines. British Thomson-Houston Co. (General Electric Co.) 12,497. May 29th.

Electric Telegraph Apparatus. S. G. Brown. 12,500. May 29th.

Shade Devices for Use in Connection with Gas, Electric Light, or with Lamps. A. B. Williamson and T. Williamson. 12,567. May 30th.

Single-Phase Alternating Current Motors. J. Brunken. 12,557. May 30th.

Electro-Magnetic Friction Clutch Reversing Gear. W. L. Spence. 12,686. May 31st.

Electrical Brake for Railway Trains. P. Morlock. 12,862. June 2nd.

Wireless Cluster Supports for Electric Lamps. W. Fairweather. (Benjamin Electric Manufacturing Co.) 12,998. June 5th.

Reflector Mountings for Electric Incandescent Lamps and the Like. P. Druseidt. 13,172. June 7th.

Electric Switches. British Thomson-Houston Co. (General Electric Co.) 13,221. June 7th.

Electric Motor Control Systems and Apparatus. British Thomson-Houston Co. (General Electric Co.) 13,691. June 14th.

Electric Induction Motor Control. British Thomson-Houston Co. (General Electric Co.). 13,844. June 16th.

Magnetic Separators. Newton, Newton & R. Newton. 13,845. June 16th.

Electro-Magnets. British Thomson-Houston Co. (General Electric Co.) 14,359. June 22nd.

Electric Measuring Apparatus. G. W. Harris. 14,592. June 26th.

Joint Boxes, Fuse Boxes, Switch Boxes and the Like for Telegraphic and other Electrical Cables. D. Bould. 14,911. June 30th.

Slipper or Cradle Applicable to Electric Tramcars and like Vehicles, to Operate in Place of Brakes or in Cases of Brakes Failing to Act. J. C. Berry. 15,100. July 3rd.

Electrically-Driven Grinding Machines for Metal and other Work. Martin. 15,376.

Intercommunication Telephone Apparatus. Electric & Ordnance Accessories Co., and R. F. Hall. 15,704. July 11th.

Systems of Control of Electric Motor-Operated Devices. British Thomson-Houston Co. (General Electric Co.). 15,984. July 14th.

Overload Protective Devices, Especially Applicable to the Control of Electric Motors. British Thomson-Houston Co. (General Electric Co.). 16,195. July 17th.

Electric Circuit Controlling Devices. British Thomson-Houston Co. (General Electric Co.). 16,361. July 19th.

Automatic Electrical Signalling Apparatus for use on Railways. Ciri. 16,693. July 24th.

Dynamo-Electric Generators. E. C. Ketchum. 16,729. July 24th.

Electric Transformers. British Thomson-Houston Co. (General Electric Co.). 16,895. July 26th.

Apparatus for Use in Starting and Controlling Electric Motors. A. Taylor, T. Eaton, and H. Schwarz. 16,957. July 27th.

Telegraphy. P. B. Delany. 17,130. July 30th.

Electrically-Controlled Lifts or Hoists. R. Waygood & Co., and H. C. Walker. 17,321. August 1st.

Electro-Magnetically Operated Valves. E. L. White and E. C. Hoegerstaedt. 17,564. August 3rd.

Systems of Electric Distribution Employing Transformers and Controlling Apparatus therefor. British Thomson-Houston Co. (General Electric Co.). 17,561. August 3rd.

Magneto-Electric Generating Apparatus, Especially Suitable for Ignition of Internal Combustion Engines. J. C. Fuller, G. Fuller, L. Fuller and B. J. Moore. 17,601. August 4th.

Single-Phase Alternating-Current Electric Motor. F. W. Davies. 17,703. August 7th.

Igniting Devices. F. Deimel. 17,976. August 10th.

Sparking Plugs. A. Hosch. 18,704. August 21st.

Central Battery Telephone Systems. Siemens Bros. & Co. (Siemens and Halske Akt.-Ges.). 18,716. August 21st.

Electric Traction Systems. L. Potterat. 19,074. August 27th.

Instruments for Straining Telegraph Wire, Fencing Wire and the Like. J. H. Wynn. 20,062. September 10th.

Form of Galvanoscope, Galvanometer, or Single Needle Instrument. W. Powles and E. E. Moore. 20,399. September 13th.

Electric Air-Heaters for Heating and Ventilation Systems, and for Analogous Purposes. T. E. Weaver. 21,279. September 26th.

Electrodes. C. C. Connor and J. W. Stubbs. 22,752. October 15th.

Electrical Bolt for Railway Carriage Doors and other Doors and Windows. W. Unsworth, A. Gibson and H. A. Leggatt. 23,456. October 23rd.

Electric Fuse Plugs. W. Matzka and W. Timmermann. 25,509. November 12th.

Process for the Soldering of Incandescence Filaments of Electric Incandescence Lamps to the Conducting Wires. H. Kuzel. 25,994. November 16th. (Date applied for under International Convention, January 20th, 1905.)

Controller Systems Chiefly for Electrically Propelled Trains or Vehicles. Siemens Bros. Dynamo Works, Ltd, C. F. Jenkin and F. Lydall. 26,148. November 19th.

Automatic Electric Car Brakes. J. H. K. McCollum. 26,998. November 27th.

Locomotives. British Thomson-Houston Co. (General Electric Co.) 28,025. December 8th.

Single-Phase Commutator Motors with Commutation Fields. Siemens-Schuckertwerke Ges. 28,100. December 10th. (Date applied for under International Convention, December 11th, 1905.)

Lighting Systems for Electric Railway Carriages and Trains. Siemens Bros.' Dynamo Works and A. M. Duke. 29,151. December 21st.

1907.

Electric Furnaces. S. O. Cowper-Coles. 596. January 9th.

Electrical Hair-Curlers. E. Konig. 2,049. January 26th.

Electric Resistance Furnaces. C. Fery and C. Langlet. 3,808. February 15th. (Date applied for under International Convention. February 17th, 1906).

Electric Vehicle Wheels. W. Kronheim. 6,515. March 18th.

Jewelled Bearings for Electrical and other Instruments. J. Wennstrom. 7,861. April 4th.

Electro-Thermostatic Switches. W. V. B. Kelley. 8,231. April 9th. (Date applied for under International Convention, April 19th, 1906.)

Bearing for the Upper End of the Shaft of an Electric Motor Meter. Allgemeine Elektricitats-Ges. 9,355. April 22nd. (Date applied for under International Convention, September 14th, 1906).